Grid Edge and Customer Programs

At the forefront of achieving the energy transition and developing comprehensive decarbonization plans to achieve the targets of North Carolina Session Law 2021-165 ("HB 951") in a least-cost manner is the need to impact load at the edge of the grid through programs, enabling investments and offers that allow for the reduction and management of load, such as energy efficiency ("EE"), demand-side management ("DSM"), customer self-generation, voltage management and other distributed energy resources ("DER"). Duke Energy Carolinas, LLC ("DEC") and Duke Energy Progress, LLC ("DEP" and, together with DEC, "Duke Energy" or the "Companies") will ensure the prioritization of these valuable resources by considering them prior to evaluating the supply-side resources required to reliably meet the system loads in Duke Energy's resource evaluation in the Carolinas Carbon Plan ("Carbon Plan" or "Plan").

The Companies' suite of Grid Edge and Customer Programs, such as EE and Demand Response ("DR"), collectively empower their customers to directly reduce or enable carbon dioxide ("CO_2") emissions reductions and support the Companies in operating the electric system in more efficient, low cost and carbon reducing ways. As Duke Energy seeks to grow the amount of energy supplied from solar and other zero-emitting resources, the Companies recognize the opportunity for additional solar growth through programs that allow the Companies to partner with customers and increase adoption of emissions-free supply generated on customers' premises. Imperative to this process is thoughtful engagement with stakeholders to solicit feedback and design programs that serve the needs of multiple customer classes and most cost-effectively support the energy transition. Such *direct* carbon reducing programs are complemented by enabling customer programs and offerings like time-differentiated rates that indirectly support and allow the use of zero-emitting resources in the Carolinas at a far greater scale.

The following sections describe three categories of current and future programs that can contribute to these targets: (1) programs that empower customers to reduce CO_2 emissions; (2) programs that dynamically manage electric demand to reduce CO_2 emissions; and (3) programs and initiatives that transform the electric system to enable more CO_2 reducing resources.

Customer Programs: Empowering Customers to Reduce CO_2 Emissions

The Companies believe that reasonable and prudent planning includes providing programs and tools that empower the Companies' customers to directly reduce their energy consumption and resulting emissions. Because the success of these programs and tools in reducing energy consumption and emissions directly depends in large part on customers and their individual decisions to invest in energy efficiency and clean energy, the Companies have designed programs to facilitate and encourage robust customer participation. Moreover, although the Companies' EE programs are designed to foster customer participation in reducing CO_2 emissions, the Companies offer customers additional ways to participate in reducing CO_2 emissions as well. These areas of customer empowering programs are discussed below.

Energy Efficiency Customer Programs

The Companies' portfolio of EE programs encourages customers to make investments or take other actions that will reduce energy usage and the associated CO_2 emissions in the Carolinas. EE programs, such as the Residential Smart $aver® Appliance and Device program, offer proven, cost-effective means for reducing both energy consumption from the grid and the associated carbon emissions.

Clean Energy Customer Programs

Clean Energy programs provide greater access to a zero-emitting energy supply, primarily via solar generation, to offer additional partnering opportunities for customers. These programs have been designed to support large commercial and industrial customers, small-medium businesses, and residential customers. These programs empower customers to support the reduction of CO_2 emissions from the Companies' electric systems by providing programs that facilitate customers' access to renewable energy, either directly, through financial incentives (such as solar rebates) or through Renewable Energy Certificates ("RECs").

Net Energy Metering Programs

Net Energy Metering programs allow customers access to zero-emitting generation, such as solar generation, at their own homes which reduces their own electricity consumption from the grid. The Companies are working to develop new and innovative programs through their net metering programs that couple rooftop solar, net metering, dynamic new rate options and dispatchable resources. The first such offering, linked to smart thermostats, has been proposed to the Commission. Full achievement of the potential adoption and system benefits requires Commission approval of the Companies' pending application.

Grid Edge Programs: Managing the Electric System to Reduce CO_2 Emissions

In addition to Customer Programs, the Companies are leveraging a second avenue for reducing CO_2 emissions through implementation of Grid Edge technologies that enable Duke Energy to manage the electric system in ways that lower CO_2 emissions. This group of programs includes a mix of customer offerings and utility technology programs designed to allow the management of the electric system (and shape overall energy loads) in ways that defer or eliminate the Companies' need to build additional peak generation resources as additional customers are added to the Carolinas electric system. The Carbon Plan includes several sets of interrelated grid-managing programs as described below.

Rate Design

Rate Design is an important load shaping tool that uses time differentiated rates and other forms of dynamic pricing to encourage customers to change their load profiles in ways that better support the Companies' use of reduced carbon-emitting resources. A large-scale stakeholder engagement initiative (the Comprehensive Rate Design Study) recently concluded and identified potential new rate designs that provide improved pricing structures and encourage behavioral changes to benefit the system. Such pricing ideas consider the growth of new energy technologies such as electric vehicles ("EV"), as well as existing loads that may be able to respond more easily to modernized pricing structures.

Demand Response Programs

Demand Response programs are already incentivizing 500,000 Carolinas' customers to allow the Companies to reduce peak energy demand on the electric system when and where needed. Duke Energy's target is to significantly increase customer participation in the future. Traditional DR programs have historically enabled the Companies to decrease their reliance on older, more expensive generation and spot market power purchases. To support the Carbon Plan, the Companies plan to evolve their use of DR to both reduce peak load and shape load in ways that help the Companies maximize their use of carbon neutral resources. To accomplish this, dynamic loads such as electric vehicles and customer-sited energy storage should be incorporated. DR programs may also evolve to help manage load shape at the local level.

Voltage Optimization (Conservation Voltage Reduction)

The Companies are utilizing systems designed to control distribution grid equipment in both DEC and DEP, as well as deploying new technology to optimize voltage, which results in reduced peak demand and energy usage. For example, DEP currently utilizes the Distribution System Demand Response ("DSDR") program that focuses on reducing megawatts ("MW") at peak (peak shaving) and is developing another solution that focuses on continuous megawatt-hour ("MWh") reductions (energy savings). DEC is also deploying systems that will primarily support the reduction of MWh. Conservation Voltage Reduction ("CVR") technology allows the Companies to conserve energy at a circuit or system

level. CVR coordinates the settings of the Companies' devices to lower the voltage for an entire circuit. This in turn reduces the load of the system, thereby lowering generation fuel consumption, which leads to lower CO_2 emissions. Duke Energy plans to expand CVR rollout in the DEC territory and plans to introduce CVR in the DEP territory to support achieving CO_2 emissions reductions targets.

Transportation Electrification and Managed Electric Vehicle Charging

Transportation electrification will lead to a significant increase in the amount of electricity consumed by vehicles as more consumers switch to EVs. A collection of rates, deployed assets and customer programs will be needed to support this significant change. Managed EV charging is a valuable solution to support lower-carbon emissions by reducing existing load peaks and eliminating risks from new ones. Managed charging strategies for residential, fleet and commercial customers vary, but each approach will leverage customer-focused design processes combining usage monitoring and control geared to avoid high-carbon generation and to improve grid stability and efficiency. The Companies provide additional details about each of these programs in the sections that follow.

Transforming the Electric System to Enable More Carbon Reducing Resources

Advanced technologies and strategies will be required to support the significant changes needed to adapt the grid to support the necessary large-scale distributed energy resource ("DER") deployment. In addition to the Grid Edge programs described above, these enabling programs include the Self-Optimizing Grid program and the associated telecommunications modernization.

Self-Optimizing Grid Program

The Self-Optimizing Grid ("SOG") Program, also known as the smart-thinking or self-healing grid, implements the distribution system design guidelines needed to support the growing penetrations of DERs. The circuits designed to meet the SOG guidelines are better equipped to address issues on the system and can be isolated to limit impacts to customers. SOG adds automation, greater connectivity and capacity to the distribution grid. These characteristics are important enablers for DER growth. The long-term vision is to serve 80% of customers by the SOG program.

Enterprise Communications Advanced Systems Program

The Enterprise Communications Advanced System program modernizes and secures critical communications between intelligent grid management systems, data, control systems and sensing and control devices. The Enterprise Communications Advanced Systems program provides the infrastructure needed for reliable and resilient communication with the grid edge devices used in the grid managing and carbon plan enabling programs described above. Examples include upgraded fiber that will increase bandwidth and reliability for the growing number of grid edge devices.

Risks to Reach Grid Edge and Customer Program Targets

The amount of annual EE (1% of eligible load) that is assumed to be achieved in the Carbon Plan modeling represents a very ambitious target. Stated differently, the Companies' proposed Plan is built on a foundation that will require substantial advancement of EE in the Carolinas in unprecedented ways. This target reflects an aggressive long-term forecast of EE savings that is more than double the level assumed in the Companies' 2020 Integrated Resource Plans ("IRP").

To achieve the amount of EE modeled in the Carbon Plan, in the near-term the Companies will need to obtain regulatory approvals associated with the addition of new programs and measures, necessary modifications associated with valuation of EE benefits, and longer-term broader modifications to expand the customers that can participate in the Companies' EE programs. Ability to receive regulatory approvals from all required authorities and jurisdictions for proposed activities may impact progression towards the 1% of retail sales EE target.

In addition to obtaining timely and needed regulatory approvals, ultimately the Companies must overcome the significant barriers to customer participation in EE programs, such as inflation, supply chain shortages and potential economic downturns. With regard to DR programs, the Companies will continue to engage stakeholders to assess the incentives needed to encourage customers to reduce peak demand through rate design and programs to manage load, such as EV-related services, and obtain the appropriate regulatory approvals to encourage increased customer adoption and participation. Even so, DR programs can be inconvenient to customers; accordingly, some customers may not be willing to participate at any price. For certain grid improvement programs that will enable energy savings and integration of distributed energy resources, there are also supply chain risks associated with obtaining necessary supplies in the currently projected timeline. Material and equipment supply chain disruptions may lead to construction delays or inability to develop certain types of programs at the costs or amounts assumed in the modeling.

About Energy Efficiency Programs

Energy Efficiency is a proven low-cost means to reduce energy consumption and CO_2 emissions and is foundational to any decarbonization strategy. The Carbon Plan includes substantially increased EE targets through potential regulatory changes that will provide for the expansion of existing programs, the addition of new technologies and potential expansion of the pool of customers that are eligible to participate in the programs.

Stakeholder engagement through the long-standing EE/DSM Collaborative has been integral in developing and refining EE/DSM programs in the Carolinas over the past 15 years. Continued thoughtful engagement with stakeholders will be critical to developing programs and strategies to achieve and potentially exceed the 1% target.

Current State Program Details

The Companies currently provide a portfolio of residential EE offerings designed to reduce energy consumption from the utility systems associated with DEC and DEP customers living in single-family or multifamily dwellings. The Companies' current residential programs are summarized in Table G-1 below.

Table G-1: Residential Energy Efficiency Programs

Residential EE Programs	
Neighborhood Energy Saver Program	Empowers low-income customers to better manage their energy usage through energy education and installation of energy-efficient measures. Includes onsite energy assessment, one-on-one education and a comprehensive package of energy-efficient measures.
Low-Income Weatherization	Helps income-qualified customers (i.e., customers with income below 200% of the federal poverty level) reduce their energy consumption and lower their energy cost in owner-occupied, single-family homes. Includes direct installation of weatherization and energy efficiency measures, such as refrigerator and furnace replacement.
Energy Efficiency Education for Schools	EE program available to K-12 grade students enrolled in public and private schools who reside in households served by Duke Energy and provides education on the importance of energy conservation and ways to lower energy bills in their homes. Includes an Energy Efficiency Starter Kit and access to gaming app (Kilowatt Krush).
Multifamily Energy Efficiency Offering	Helps bridge gap for multifamily units, where often neither property managers/owners nor the tenants are motivated to make EE improvements, by educating property managers/owners about EE benefits and providing a low-cost/no-cost EE solution for the multifamily dwellings.
Residential Energy Assessment	Offers a free in-home assessment designed to help customers reduce energy usage and energy cost. Includes on-site analysis of energy usage in the home and a customized report to identify actions the customer can take to save energy.
Smart $aver Residential	Serves as an umbrella program for the incentivized energy-efficient equipment. The program includes access to: • Specialty Lighting and other energy efficient products • Retail Lighting • Save Energy and Water Kit • HVAC Equipment • Attic Insulation and Air Sealing • Duct Sealing • Heat Pump Water Heater • Variable-Speed Pool Pump

Residential EE Programs	
My Home Energy Report	Provides customers in both single-family and multifamily residences with a comparison of their energy usage to those in the same geographical locations and similar dwellings to encourage energy-saving behavior.

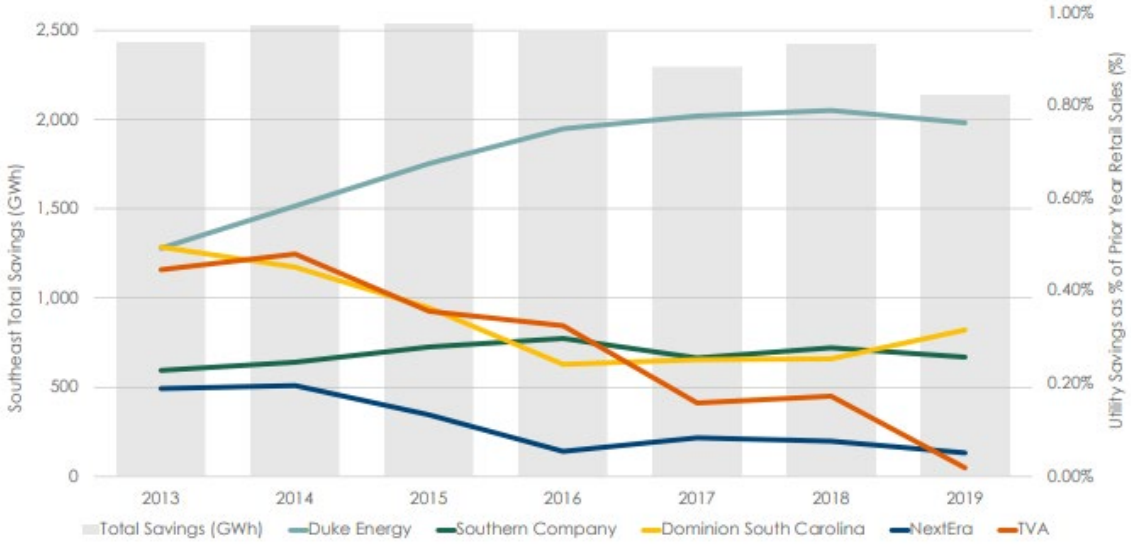
The current portfolio of EE offerings also includes a suite of energy-saving measures designed to support Duke Energy's non-residential customers summarized in Table G-2 below.

Table G-2: Non-Residential Energy Efficiency Programs

Non-Residential EE Programs	
Small Business Energy Saver	Reduces energy usage through the direct installation of EE measures within qualifying small and medium non-residential customer facilities. Small Business Energy Saver is designed to offer a convenient, turn-key process for non-residential customers to make facility energy efficiency improvements.
Smart $aver Non-Residential	Serves as an umbrella program providing incentives to commercial, industrial and institutional consumers for installation of energy efficient equipment in applications involving new construction, retrofit and replacement of failed equipment. Includes three incentive types: • Prescriptive Incentives: Pre-determined, fixed incentives to promote use of common energy efficient technologies (e.g., lighting, HVAC, pumps, variable frequency drives, food services, process equipment and information technology equipment) • Custom Incentives: Incentives for pre-approved customer-proposed projects that demonstrate a clear reduction in electrical consumption and/or demand • Performance Incentives: Incentives encouraging the implementation of energy conservation measures, which are characterized, at the time of conception, by a degree of uncertainty associated with the end-result due to unknown building conditions or system constraints, coupled with uncertain operating, occupancy or production schedules.

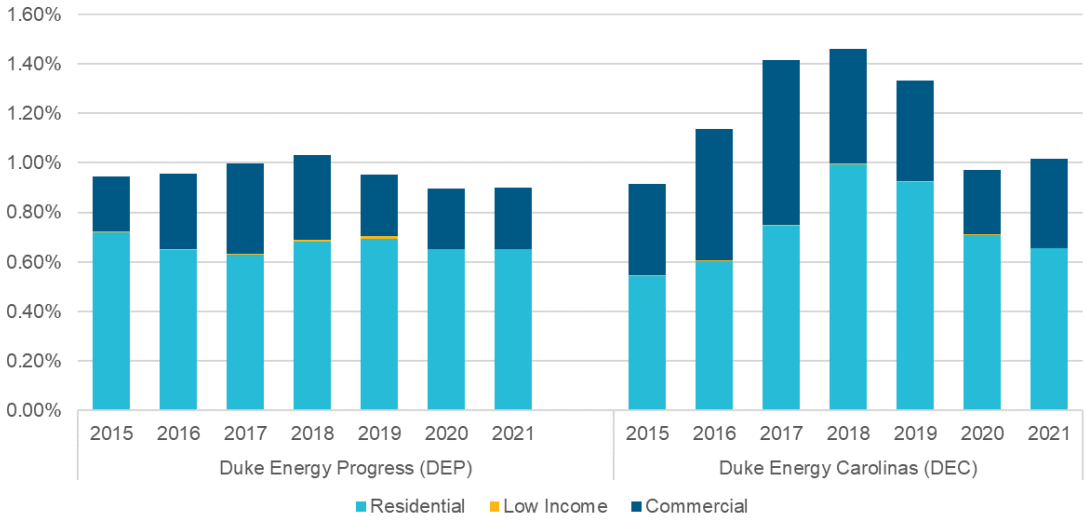
The energy savings delivered from the Companies' EE programs accounted for nearly 60% of the Southeast region's total efficiency savings prior to the COVID-19 disruption. The Companies' current EE portfolio substantially exceeds the national average for energy savings, delivering more than two times as much efficiency as any of Duke Energy's Southeast utility counterparts as reflected in Figure G-1 below.

Figure G-1: Pre-COVID-19 Energy Savings as a Percent of Prior Year Retail Sales by Utilities in the Southeast Region[1]



The Companies have been utility leaders in modifying their programs and instituting new safety protocols to minimize program disruption throughout the shifts driven by the regional pandemic response. As a result, projected savings targets for 2020 and 2021 have been achieved as reflected in Figure G-2 below.

Figure G-2: DEC and DEP Energy Savings as a Percent of Prior Year Retail Sales through 2021



[1] Southern Alliance for Clean Energy, *Energy Efficiency in the Southeast*, at 7 (January 26, 2021), *available at* https://cleanenergy.org/wp-content/uploads/22Energy-Efficiency-in-the-Southeast22-third-annual-report-2021.pdf.

In 2020, the Companies filed their IRPs in the Carolinas that provided EE savings projections for the 2020 to 2035 timeframe as shown in Table G-3 below.[2] The projected energy savings reflect the 2020 to 2025 energy efficiency budget information for the Companies' 15-year planning horizon and additional input from the Companies' Market Potential Study to support longer-range energy-saving estimates.[3]

Table G-3: 2020 NC and SC IRPs* Residential and Non-Residential Energy Savings Projections for 2020 to 2035

	Projected kWh Savings from EE	@ 1%	Delta
Res DEC-NC	1,143,861,799	1,676,061,466	532,199,666
Res DEP-NC	904,098,938	1,337,580,669	433,481,731
Total Residential (NC)	2,047,960,738	3,013,642,135	965,681,397
Non-Res DEC-NC	2,533,976,132	3,152,073,947	618,097,815
Non-Res DEP-NC	1,076,047,028	1,495,773,503	419,726,475
Total Non-Residential (NC)	3,610,023,160	4,647,847,450	1,037,824,290
Total Projected NC Savings	**5,657,983,898**	**7,661,489,585**	**2,003,505,687**

* Underlying 2020 Spring Forecast updated for 2022 Spring Forecast

Future Energy Efficiency Program Changes (Planned and Proposed)

In order to achieve the HB 951 70% CO_2 emissions reductions target while maintaining reliability and affordability, the Companies are exploring additional ways to expand the reach of their existing energy-saving programs, accelerate the development of new EE measures for customers and examine where stakeholders may be engaged to reduce barriers and unlock additional EE savings. Currently, stakeholders have engaged via the EE/DSM Collaborative to actively explore avenues for increasing the beneficial impacts of the Companies' EE measures and programs. This need to reduce barriers to unlock additional EE opportunities was also discussed with stakeholders throughout the Carbon Plan Stakeholder Meetings. As the Companies work to implement some of the currently identified and future enablers, they will continue to look to stakeholders for critical input and support of their implementation, so Carbon Plan stakeholders have been invited to participate in future EE/DSM Collaborative meetings.

Through the EE/DSM Collaborative, the Companies have identified several actions that will provide more income-eligible customers with access to their energy-saving measures based on these insights.

- Refining and expanding the definition of low-income eligibility of customers for the Companies' income-qualified programs that would include moderately low-income customers (incomes

[2] The Companies' 2020 Integrated Resource Plans may be accessed at www.duke-energy.com/our-company/about-us.

[3] The Companies' most current Market Potential Study may be found in Attachment IV of this plan.

<300% of the Federal Poverty Level) to support customers who have a significant or disproportionate energy burden and/or energy intensity but do not currently qualify based on existing definitions of income-qualified. This customer segment has grown dramatically given the pandemic's impact on middle-class customers throughout the Duke Energy service territory.

- Expanding the existing DEC Weatherization program to DEP customers including offering (i) weatherization measures and/or (ii) heating system replacement with a 15 or greater seasonal energy efficiency ratio ("SEER") heat pump and/or (iii) refrigerator replacement with an ENERGY STAR® appliance. The measures eligible for funding will be determined by a full energy audit of the residence.

- Pursuing Commission approval of the Energy Burden Reduction Pilot program that will install deep retrofits at no cost to customers with the aim of permanently reducing energy bills for individual customers. This program will target high-energy (electricity) use customers, with an emphasis on low-income neighborhoods with mobile/manufactured homes.

- Expanding the existing Neighborhood Energy Saver program measure to include additional deep retrofits and replacements including but not limited to HVAC replacement, heat pump water heater and window improvements. The measures eligible for funding will be determined by a full energy audit of the residence.

These low-income program modifications provide substantial long-term value to qualified customers while reducing CO_2 emissions.

Invest in Tailoring Offers for High-Potential but Low Participating Segments

With respect to the specific needs of different segments of the Non-Residential market, investments in program marketing and incentives would enable the Companies to better tailor EE offerings to meet those specific needs. The Companies have estimated nearly 350 gigawatt-hours ("GWh") of total energy savings by 2030 attributable to the programs described in Table G-4 below.

Table G-4: Example Tailoring for Non-Residential Segments

Example Tailoring for Non-Residential Segments	
Expanding Direct Install	Small and medium businesses often struggle to focus on EE opportunities and greatly benefit from direct install efforts, such as Small Business Energy Saver. The direct install model is approximately 15% more costly than the Trade Ally-driven model, but the success rate is higher with approximately 33% of customers agreeing to install the proposed EE project. Expanding the market of eligible customers could increase direct install participation by 50%, or approximately 77 GWh over an eight-year period.

Example Tailoring for Non-Residential Segments	
Compensating Trade Allies	The existing Smart $aver program derives approximately 30% of program impacts from Trade Allies ("TA") that sell and install EE projects and apply for incentive payment. Many TAs struggle to pay for the administrative staff needed to comply with program rules, which creates a disincentive for the TA to recommend eligible EE measures. Additional program administration funding could be used to compensate TAs for their administrative costs and/or provide program specialists to complete those tasks for them, leading to an estimated 20% increase in TA participation, or approximately 102 GWh over an eight-year period.
Developing Large Commercial and Industrial Carbon Reduction Plans	Large commercial and industrial customers have better access to resources and capital for EE projects, but many lack the knowledge/ability to identify, prioritize and manage projects. The IRP forecasts a 0.5% average annual growth rate for commercial and retail GWh from 2021 to 2035. Additional program costs could be used to add carbon reduction consultants devoted to large customers that will develop strategic carbon reduction plans and help manage implementation of the energy reducing projects.
Increasing Incentives	Analysis of program data associated with small business customers indicate that customers are significantly more likely to invest in an EE improvement when the incentive is 50% of the customer's out-of-pocket cost. Currently, less than half of all prescriptive measures are set at or above 50% of the estimated incremental measure cost, and total project costs are often higher than the estimated incremental measure cost. Recent inflation of equipment and labor costs will make effectively incentivizing a higher percentage of costs an even greater challenge. Increasing customer incentives by 20% is estimated to lead to a 14% increase in prescriptive measures that will offer customers an incentive that is above 50% of incremental measure cost, leading to approximately 10% more projects being completed, or approximately 170 GWh over an eight-year period.

Offer Options that Reduce Financial Barriers to EE Program Participation

Duke Energy recognizes that while customers are often willing to replace inefficient equipment to save energy, they may not always be in the position to cover the sizeable upfront costs that come with the purchase and installation of new HVAC systems or a replacement hot water heater. Several utilities across the country have had years of success helping customers overcome this barrier through offering on-tariff financing options. Using methods such as utility-backed (on-tariff) and third-party backed financing, these utilities allow customers to break their equipment replacement costs down into manageable monthly payments that are collected via their monthly energy bills.[4]

The Companies are currently developing an on-tariff financing pilot aimed at learning how to support residential customers to reduce their energy usage in concert with existing EE programs through

[4] Utilities seeing success with offing on-tariff financing include United Illuminating Co., Baltimore Gas & Electric, Sacramento Municipal Utility District and National Grid New York.

tariffed EE improvements that are paid for through monthly energy bills. For residential customers, the pilot program would propose that Duke Energy will pay for the installation and equipment up-front, and maintenance service for any or a combination of any of the following improvements: HVAC replacement, water heater replacement, attic insulation and smart thermostat.

The program would provide participants with access to low-interest financing options, which might not have otherwise been available, without the need for credit checks or home liens. When a participant moves out of the residence prior to completing the on-tariff financing agreement, the next resident will automatically take over the monthly payments as they are realizing the energy and bill savings realized by the premises.

The program would target residential customers with high winter peak loads and annual high energy usage per square-foot (nearly 500,000 North Carolina customers). Additional cost recovery mechanisms will likely be needed outside of the established EE/DSM Rider to recover the repayment portion of the offer.

Program Schedule

The Companies will continue to leverage stakeholder engagement to develop new programs and enhance the existing EE portfolio. As detailed above, the Companies have already started work on developing a pilot for an on-tariff financing option with residential customers and are investigating the potential feasibility of a nonresidential on-tariff financing option for consideration in 2023.

Program Enablers/Signposts

Finally, in addition to the ongoing work to better leverage the Companies' EE programs for CO_2 emissions reduction, regulators and other stakeholders also play a role in facilitating the enablers required for the expansion of EE program participation across the Carolinas that will enhance the Companies' ability to meet the forecasted level of energy efficiency included in the Carbon Plan.

EE Cost-Benefit Modification

To achieve the aggressive EE assumptions of 1% of eligible retail sales as assumed in the Carbon Plan, which the Companies will strive to achieve through programs offered to customers in both North Carolina and South Carolina, the Companies will need to modernize the current framework for appropriately valuing demand-side DERs so that EE and other demand-side customer programs are evaluated on par with zero-carbon supply-side alternatives. The Companies request, as part of the Commission's approval of the Plan, that the Commission also approve the Companies' plan to update the inputs underlying the determination of the utility system benefits in the Companies' approved EE/DSM Cost Recovery Mechanism. The Companies will vet these updates with EE/DSM Collaborative members in the Carolinas and other interested stakeholders. The updated inputs utilized for justifying demand-side utility programs will be based on specific costs associated with the selected marginal carbon free and storage resources in the approved Carbon Plan added to the system energy and capacity, inclusive of transmission and other required infrastructure. More specifically, the per kilowatt ("kW") avoided capacity benefits and per kilowatt-hour ("kWh") avoided energy benefits used

will be derived from levelized average marginal supply-side resource costs utilized in the most recently approved Carbon Plan production cost model. The calculation of the underlying avoided energy value to be used to derive the specific avoided energy benefits will be based on the projected demand-side resource's hourly shape.

This necessary update to the evaluation of the utility system benefits associated with demand-side resources will also ensure the cost benefit metrics used to evaluate and compensate EE and other demand-side DERs enabled through customer programs appropriately recognize the customer benefits and risk reduction of zero-carbon demand-side programs on a consistent basis relative to zero-carbon supply-side alternatives in the Carbon Plan. Commission approval of this proposal and the required recognition of the customer benefits and risk reduction of zero-carbon demand-side programs on a consistent basis relative to zero-carbon supply-side alternatives in the Carbon Plan, will enable the Companies to offer and operate programs in manner that allows the Companies to achieve the amount of demand-side energy and capacity envisioned in the Plan while saving customers money by cost-effectively avoiding unnecessary supply-side investments.

Consider Ways to Drive the Overall Market Toward Energy Efficiency

The Companies believe there are additional opportunities to work with regulators and government agencies to reduce energy usage. Specific areas of focus are detailed below.

As-Found Baseline for Energy Efficiency Measures

The utility cost test ("UCT") cost-effectiveness test is used to evaluate the amount of EE incentives for Smart $aver Business and Residential. As part of the cost-effectiveness assessment, the UCT considers the present value of the cost versus the energy savings benefit of an EE measure over the life of that measure. The energy efficiency benefit for a given EE measure (such as an upgrade to a more efficient HVAC unit) is based on the difference between the "baseline" efficiency and efficiency of the measure being installed. Today, the baseline used in the UCT is the minimum efficiency and performance requirements set by the federal government, rather than the efficiency of the unit being replaced (i.e., the "as-found" condition), and may not fully incorporate the actual energy savings benefit. As a result, customers are not being offered incentives that reflect the true energy efficiency value their installed EE measures provide. To lower a customer's incremental cost for a project, an EE measure should be incentivized using the "as-found" baseline. Offering energy efficiency incentives through an "as-found" baseline has potential for greater kWh savings. Duke Energy will be seeking approval to offer incentives using the "as-found" baseline as a new option for identified measures. In addition to the approval, the Companies would like to ensure evaluation, measurement and verification ("EM&V") agrees with baselines used to avoid future adjustments. The additional energy savings recognized by moving to an "as-found" baseline, will potentially add 20% more savings on identified certain measures, not only better aligns with the actual CO_2 reductions realized but will also enhance the cost-effectiveness of programs. Specific program enablers include:

- Using an "as-found" baseline will allow Duke Energy room to provide higher incentives and more accurately account for savings.

- Expanding Residential Smart $aver portfolio to include new measures that promote higher incentive for customers to adopt early replacement on their HVAC system. The offer encourages customers to replace rather than make repairs that prolong the existing life of inefficient systems or installing mismatch equipment types with little efficiencies gained from out-of-pocket expense. Incentive will be paid out assuming 10 SEER as the baseline SEER rating and may be tiered according to the SEER level of the replacement system.

Code Compliance for Non-Lighting

The U.S. Energy Information Administration projects that delivered energy for air conditioning will increase more than any other end use in commercial buildings through 2050. The incentives for non-lighting equipment are rarely used in the current Smart $aver Business program. Customers are not motivated to replace air conditioner or heat pump units due to the low rebates and high cost of replacing equipment. The program is seeking approval to incentivize customers to replace equipment prior to failure with new units requiring minimum code standards only. The incentive will be offered in combination with a control system, thermostat or other identified measures for bundle and will potentially add an additional 15% more participation in identified measures.

The Companies believe that offering incentives on the less expensive, standard units, will motivate customers to replace this equipment early, and meet the rapidly changing code requirements. Duke Energy has existing programs to incentivize customers to make improvements. Customers need support in keeping up with the rapidly changing federal code standards.

Advance Codes and Standards Adoption

Fast-tracking the State's adoption of commercial building energy codes will ensure energy efficiency is used at the time of construction or retrofit. The Companies will develop a new program to support state energy code policies by offering training and assisting in promoting compliance with codes. Duke Energy is seeking approval to update the existing Smart $aver tariff to allow the Companies to improve the market's compliance with existing and future standards through education, outreach and technical support. The Companies will claim impact savings for projects influenced to meet or exceed the state of North Carolina building codes. The new program could potentially account for 5% of overall program savings in the future.

Duke Energy believes that educating non-residential customers on state and federal building codes in the planning and construction stages is key to compliance adoption. Duke Energy can support the state of North Carolina's building code requirements by using existing field teams and marketing efforts to promote understanding and adoption of required codes.

Table G-5 below summarizes future activities and needs to support achieving EE targets in the Carbon Plan.

Table G-5: Carbon Plan Activities and Supporting Needs (Energy Efficiency)

Carbon Plan Activities and Supporting Needs (Energy Efficiency)	
Expanded Low-Income Programs	The Companies will seek Commission approval of pilots and adoption of Low-Income Affordability Collaborative recommendations.
On Tariff and Other Financing Options	The Companies will seek approval of a cost recovery mechanism associated with the proposed programs that will enable the reduction to the upfront financial barriers to energy efficiency investments.
Cost-Effectiveness Test Modifications	The Companies will seek Commission approval to update the inputs underlying the determination of the utility system benefits in the Companies' approved EE/DSM Cost Recovery Mechanism.
As Found Baseline Adoption and Code and Standard Attribution	Moving to an "as found" baseline increases savings associated with EE investment, thereby increasing the potential incentive amount that can be provided to customers. Approval of the measures associated with "as found" energy savings is needed for this transition.

Clean Energy Customer Programs

The Companies have developed several customer-focused clean energy programs to provide an array of options for customers seeking to meet their own sustainability targets and to support overall decarbonization plans across the Carolinas. There is a significant opportunity across the dual-state systems to continue to grow these customer-empowering solutions, while deploying clean energy across the Duke Energy footprint. Notably, development of new, innovative programs and marketing approaches can enable the aggressive customer adoption assumptions, but it does not ultimately deliver carbon reductions. Only actual customer participation in programs can deliver reductions, so it is critical that the Companies monitor this participation to ensure that the Companies can update the Carbon Plan accordingly.

Current State Program Details

The Companies' current portfolio of clean energy customer programs consists of offerings that include an off-site solution for large customers to have access to renewable energy options, a solar rebate program and a renewable energy credit program.

Green Source Advantage

The primary clean energy customer program offering for large customers is the Green Source Advantage ("GSA") program.[5] The GSA program offers large customers the flexibility of selecting and

[5] Preceding the GSA Program was the DEC NC Green Source Rider pilot program, which was one of the first programs in the country through which the utility could source renewable energy credits to non-residential customers.

negotiating all price terms directly with a renewable energy supplier of their choice, as well as retaining renewable energy certificates ("REC"s) generated by the renewable facility. The customer and renewable energy supplier can also agree on the contract length that is right for them. North Carolina and South Carolina each have their own approved GSA program, and eligible renewable energy facilities can be located in either state. Together, the GSA program offers up to 800 MW of third-party solar capacity to eligible customers.[6] Currently, customers have contracted for approximately 246.5 MW of GSA capacity.

NC Solar Rebates

DEC and DEP also offer a rebate incentive program for rooftop solar installations for their residential, commercial and industrial customers, as well as non-profit customers of the State. Participating customers must be on a net metering rate and agree to keep the system operational for at least 10 years.

The Companies comply with the capacity limits for each of the customer classes as established in North Carolina Gen. Stat. § 62-155. Because the program has been highly popular, customer demand has outpaced the capacity availability. To ease the application process for customers, the Companies developed a lottery selection process in January and June of each year to award the rebates. The NC Solar Rebates program expires on December 31, 2022. To the extent there is unused capacity for non-profit customers after December 31, 2022, however, the program is scheduled to have the last incentives allocated in January 2023. Table G-6 below includes the capacity granted through January 2022, as well as remaining capacity of the program.

Table G-6: Current NC Solar Rebate Program Capacity Granted (kW)

Year	Residential	Commercial	Non-profit
2018	12,228	1,805	895
2019	12,056	3,093	1,488
2020	14,400	2,354	1,607
2021	12,370	2,617	6,175
2022	5,540	1,794	920

Renewable Advantage

The Companies' Renewable Advantage program provides customers with the opportunity to purchase and pair RECs with their Duke Energy electricity service to receive the benefits of and build a market for renewable electricity. Customers may purchase RECs that the Companies acquire from the market, that have been created from solar and biomass facilities located in over a dozen states across the country, including Georgia, Mississippi and Arkansas.

[6] 800 MW of GSA capacity includes 600 MW approved in North Carolina and 200 MW in South Carolina.

Future Clean Energy Customer Program Changes (Planned and Proposed)

The Companies see opportunities to expand their existing clean energy customer programs and also create new clean energy programs for customers with the enactment of HB 951. The law supports a rider for both residential and non-residential customers who voluntarily purchase renewable energy or RECs. Through the Carbon Plan stakeholder process, Duke Energy heard customers' desire to participate in clean energy programs, and in the coming months, the Companies will be engaging more specifically with stakeholders to discuss the ways in which clean energy programs may be expanded or newly designed to meet customers continued desire to support renewable and clean energy.

Large Customer Clean Energy Program Options

The Companies' clean customer programs revolve around three areas, described below.

Self-Sourced Renewable Energy: These programs would help to enable customers to directly adopt or support new renewable energy facilities either on the customer's premises or connected to the grid. These types of programs would build upon the success of the NC Solar Rebate and GSA Programs and are designed for customers who are able to dedicate a large investment of time and capital to meeting their clean energy targets.

Utility-Sourced Renewable Energy: Many customers have clean energy goals but are not interested in, or able to be as directly involved in, the transaction as a Self-Sourced Renewable Energy option would require. For these customers, the Companies intend to explore additional options to create new REC program offerings to provide or procure the renewable attributes of renewable energy for customers through RECs. Additionally, the Companies will work with stakeholders to develop new and modify existing Community Solar programs. These programs may require modifications to recovery mechanisms and will require regulatory approval and potentially legislative changes.

Battery Storage: Battery Storage has the potential over time to enable customers to better align their renewable energy production with their consumption as well as to manage their load in such a way to reduce system costs over the long run. The Companies are in the early stages of developing programs that would help support the adoption of battery storage by customers to support their clean energy targets.

As noted previously, future programs will be informed by customer engagement and feedback to arrive at targets that support customer clean energy goals, increase the amount of clean energy on the system and comply with the targets of HB 951.

About Net Metering Programs

Duke Energy has several programs that have been developed over the last several years to create better customer engagement and sustainability around clean energy, primarily solar. There has been a strong focus recently on net metering reform, tying net metering to time-of-use ("TOU") schedules

and developing new and innovative programs coupling rooftop solar, net metering, TOU and EE offerings. This section will define the current net metering impact, the future programs being researched, and the enablers required to allow these programs to deliver on a more carbon-free future.

Current State Program Details

Net metering is currently available in the Carolinas in DEC and DEP. Table G-7 below summarizes the number of current customers enrolled in a net metering rate for both the DEP and DEC service areas by customer class as well as the total energy (MWh) forecasted to be generated from behind-the-meter solar generation on customer sites in 2022.

Table G-7: Number of Customers Enrolled in Net Metering Rates and Forecasted Behind-the-Meter ("BTM") Generation

	2022 Enrollment (as of January 1, 2022)		2022 BTM Generation Forecast	
System	Residential	Non-Residential	Residential	Non-Residential
DEC	22,252	745	223,447 MWh	86,816 MWh
DEP	14,017	477	138,325 MWh	44,755 MWh

Table G-8 below shows the Companies' projection of growth in new solar customers from 2022 through 2030 under the currently approved net metering rate designs in the Carolinas as of January 1, 2022.

Table G-8: Number of Forecasted Customers and Incremental MWh Enrolled in Net Metering Rates and Forecasted Behind-the-Meter Generation by 2030

	DEC		DEP	
	Residential	Non-Residential	Residential	Non-Residential
Customers	38,464	1,050	20,839	846
MWh	354,255	92,192	189,168	62,092

Future Net Metering Program Changes (Planned and Proposed)

Duke Energy recognizes it is critical to CO_2 emissions reduction efforts to continue exploring innovative net metering program structures that create incentives for customers to participate in net metering. Engaging with stakeholders is an important component of this future program development. Proposed net metering programs, described below, were developed based on significant collaboration with rooftop solar industry participants and environmental advocates. Broad engagement is imperative going forward to design programs that fulfil the needs of customers and industry alike.

Solar Choice Net Metering

In the Carolinas, Duke Energy has proposed the Solar Choice Net Metering option. This option has been approved in South Carolina and is pending in North Carolina.[7] This offering will include dynamic rates that vary based on the time of day and peak demand and will integrate with other EE and DR measures (e.g., smart thermostat with their solar panels) to offer customers additional participation incentives. The Companies are currently seeking approval of those new measures in North Carolina.[8]

New Rate

If approved by the Commission, the net metering rate design will be adjusted in January 2023 to more closely reflect the avoided costs associated with behind-the-meter solar generation. A key element of this improved rate design will ensure that customers are fairly compensated for the value provided by their solar systems in reducing energy consumption from the grid with reduced cross-customer subsidization by non-solar customers. This will fundamentally change the customer requirements and economics associated with behind-the-meter solar generation investments; however, this new rate design is a more sustainable approach to compensating customer-sited solar generation and will ensure that the lowest-cost solutions are realized for meeting HB 951 CO_2 emissions reductions targets. This will also provide stronger price signals on the value of behind-the-meter storage as those technology costs decline and customers become more interested in adopting hybrid solar and storage systems.

Proposed New Complementary Program

The Companies filed for Commission approval of the Smart $aver Solar EE program in December 2021. This proposed program offers eligible residential customers an upfront incentive associated with investment in rooftop solar. Customer eligibility for the incentive requires them to use electricity for space and water heating, agree to take service under the new net metering rate design and agree to participate in the Companies' Winter-Focused Bring-Your-Own Thermostat demand response program offering for a period of 25 years. This proposed program will support increased customer adoption of rooftop solar that is more reflective of the benefits provided by the customer's system with consideration of the customer's usage characteristics.

The Companies recognize the potential need to bundle behavioral demand response programs, such as Peak Time Rebates, or other load management tools with rate design options to encourage adoption and enable additional responsiveness. As availability and customer interest in distributed energy technologies increases, the Companies will seek ways to harness the usefulness of these various devices through product offerings that work with well-designed rate structures to provide value to both the customer and the overall system.

[7] PSCSC Order No. 2021-390, Docket Nos. 202-264-E & 2020-265-E (May 30, 2021); Investigation of Proposed Net Metering Policy Changes, Order Requesting Comments, Docket No. E-100, Sub 180 (January 10, 2022).
[8] Application by Duke Energy Progress, LLC and Duke Energy Carolinas, LLC for Approval of Smart $aver Solar Energy Efficiency Program, Docket Nos. E-2, Sub 1287 & E-7, Sub 1261 (Dec.16, 2021).

As these bundled product offerings are developed and introduced to customers, this will likely lead to a greater uptake of behind-the-meter solar throughout the mid and latter half of the decade than is reflected in the base Net Energy Metering ("NEM") forecast.

Program Enablers/Signposts

To support the Companies' achievement of decarbonization targets, new net metering rates must be implemented to ensure customers are well-informed of the compensation they can plan to receive for their solar investment. This will include the necessary technology changes, educating solar installers, creating new marketing material and training Duke Energy's workforce to successfully communicate the benefits of this program. Table G-9 below shows Carbon Plan activities and supporting needs for NEM programs.

Table G-9: Carbon Plan Activities and Supporting Needs (Net Energy Metering Programs)

Carbon Plan Activities and Supporting Needs (Net Metering Programs)	
Solar Choice Net Metering Policy Changes	• Obtained approval in South Carolina and seeking approval in North Carolina to align net metering rates to more closely reflect the avoided cost for behind-the-meter solar generation
Smart $aver Solar Program	• Seeking approval of the proposed Smart $aver Solar program to improve the economics for residential solar customers • Revisiting program eligibility requirements (i.e., winter DR participation to enroll in Smart $aver Solar) • Seeking future approval to expand program to non-residential customers

About Rate Design to Support Grid Edge and Customer Programs

Achieving the energy transition and meeting the Carbon Plan CO_2 emissions reduction targets present several opportunities for meaningful contributions including informed and thoughtful rate design in anticipation of a rapidly transformed energy resource mix. The energy transition will likely rely on large amounts of variable generation and therefore will likely require significant investment in flexible resources, such as battery energy storage systems, other energy storage technologies and fast starting gas combustion turbines to provide a bridge to carbon neutrality. The electrification of transportation and buildings will have a sizeable impact on load profiles that will ultimately change the marginal cost of generation. Avoided cost calculations will become even more dependent on the time of day with the potential to increase cost differentials for time-of-use and other dynamic pricing mechanisms, such as critical peak pricing or hourly pricing. These changing economics will create increased value for customer load shifting through time-of-use rates and demand response programs. Transportation electrification has significant potential to reduce average electricity costs if the appropriate pricing signals are provided to customers to encourage electric vehicle charging at times when demand is lower, or intermittent renewable resources are available (i.e., solar and wind). This

could be a key contributor to maintaining affordable electricity rates in a low-carbon future and is deserving of further study and analysis.

Duke Energy is committed to studying all modern pricing opportunities to encourage customer behaviors that support the affordable transition to a low-carbon electricity system while maintaining reliable service. The Companies will leverage input from stakeholder engagement efforts, such as their Comprehensive Rate Design Study and the Low-Income and Affordability Collaborative, to identify potential approaches for rate redesign with this future in mind. It will likely be necessary to pilot multiple rate options to identify and address unintended consequences and develop a well-tested set of rate approaches before making alternative rate options widely available as the default rate.

Current State Program Details

Currently, the Companies offer three modern pricing structures that potentially support Carbon Plan targets, including Hourly Pricing, Beneficial Electrification and Residential Winter Peak Management (Dynamic Pricing).

Hourly Pricing Tariffs

The Companies offer hourly marginal pricing to larger customers with incremental or new loads, on the basis that those incremental loads will only drive costs on a marginal basis, and therefore need only cover a small amount of system fixed costs. Full embedded cost, through cost-of-service methods, is recovered from existing, non-incremental loads that are currently on base tariffs designed for such cost recovery.

The Companies also offer marginal price options for incremental loads in both DEC and DEP; however, historically only about 30% of participants on Duke Energy's real-time pricing rate respond to periods of very high pricing. Certain pricing and availability challenges exist in the current programs, such as administratively burdensome management requirements and limited system cost support for non-price responsive loads, effectively limiting the benefits of price-responsiveness that could be obtained through such programs.

Beneficial Electrification

Beneficial electrification, sometimes referred to as strategic electrification, refers to replacing existing fossil fuel technologies with electric-powered technologies to reduce overall CO_2 emissions and potentially lower energy costs.

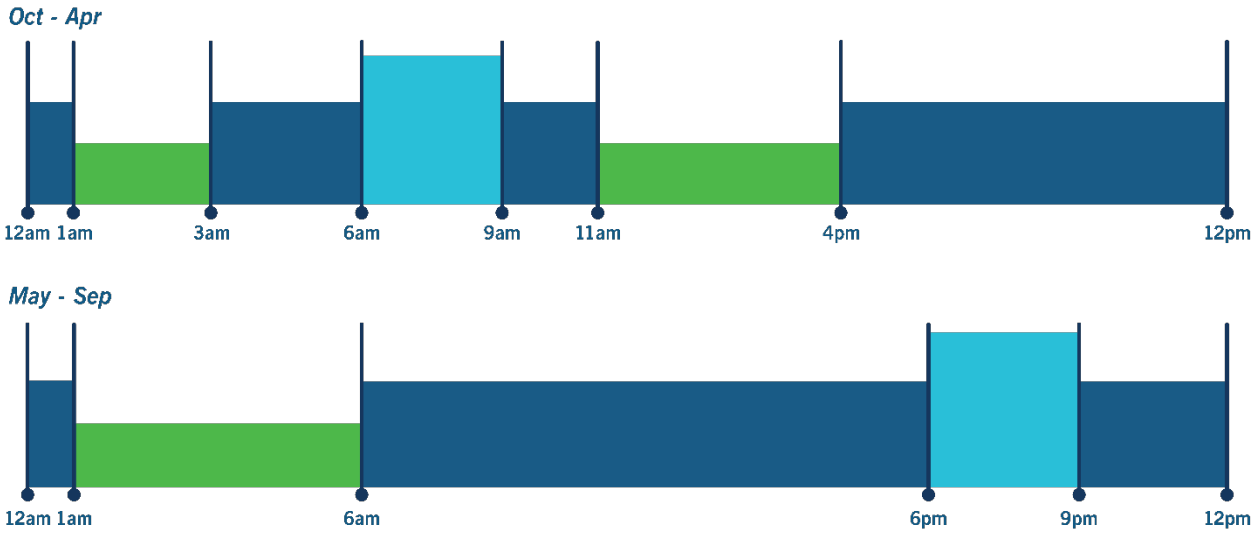
Examples of beneficial electrification include:

- Consumer adoption of EVs to replace internal combustion engine vehicles that rely on gasoline
- Customers who rely on heating oil or propane for space heating voluntarily converting to electric heat pump systems

The Companies project that there will be accelerated customer adoption of EVs and conversion to electric heat pumps as these alternative technologies become more cost-competitive with traditional technologies and gasoline and propane costs potentially become more volatile. Dynamic pricing structures, such as time-of-use, real-time, critical peak and season pricing can all improve the economics of beneficial electrification.

Pricing structures in the Carolinas are currently being updated[9] to reflect changes in hourly energy costs given higher rates of solar penetration. Increased reliance on solar is driving down prices during peak solar production time periods, particularly mid-day during shoulder months, while driving up prices during early evening hours when solar initially becomes unavailable and net load (i.e., demand less wind and solar) sharply rises. The Companies anticipate offering lower pricing for residential and non-residential EV charging during times of high solar production and higher pricing in other time periods. This should encourage EV owners to charge during times when there is abundant solar to avoid system curtailment of solar that results in higher average electricity costs. While current studies indicate that most EV charging will occur at residential homes and most residential EV charging will likely take place overnight, the analysis indicates that there is potential for 5%-15% of EV charging (residential and fleet) to be shifted to hours shown in Figure G-3 below, with lower prices.[10] See Transportation Electrification discussion later in this Appendix for additional details. The Companies are currently exploring ways to provide even more attractive pricing options for customers who allow the Companies to actively manage their charging to target times when solar resources may otherwise be curtailed or, alternatively, discharge when grid constraints exist temporarily in specific locations, providing localized grid support. The following figure represents new TOU pricing periods.

Figure G-3: New Time-of-Use Pricing Periods



[9] *See infra* p. 25 (Future Transportation Electrification Program Changes (Planned and Proposed), Rate Designs).

[10] Reflect a conservative estimated of percent EV load shifting across proposed and potential future EV programs and rates.

Residential Peak Load Management and Dynamic Pricing

Residential winter peak loads for customers who use electric heat pumps can be three times the summer peak load due to the use of resistance heating elements. Accordingly, Duke Energy commissioned Tierra Consulting ("Tierra") to perform a study to evaluate opportunities for addressing winter peaks through TOU and Critical Peak Pricing ("CPP") rates, as well as bill certainty programs with peak reduction strategies. Supporting technologies and peak reduction strategies include smart programmable/responsive thermostats, water heaters and equipment tune-ups. CPP is a form of TOU rate which includes callable events that send a high price signal to encourage customer load reduction during times of grid constraints to avoid the higher energy price, typically limited to a specific number of annual events.

While certain customers will feel comfortable leveraging technology to proactively manage loads and reduce costs on these new rate programs, some customers may be uncomfortable given the uncertainty, lack of time or desire to manage energy use, or simple fear of the unknown. These customers, who may be on a fixed income or very budget conscious, may appreciate the security of monthly bill certainty and avoidance of high bills as much or more than the possibility of savings. In order to engage these customers in the Companies' peak reduction efforts, bill certainty and Peak Time Rebate programs, combined with energy management tools and Duke Energy support, may prove more popular and reach a broader set of customers than mere availability of even well-designed TOU tariffs. The primary target market for these plans will include residential and small commercial and industrial customers who would benefit from a guaranteed monthly rate or are interested in receiving free or incentivized grid-interactive technologies (e.g., smart thermostats, water heaters or controllers, etc.). Large commercial and industrial customers who have opted out of the EE Rider may also be attracted by the opportunity to earn Peak Time Rebates through load reductions during grid constraints while retaining the flexibility to bypass individual events where a production or business interruption would be more costly than the potential Peak Time Rebate incentive.

A key benefit of this tariff design is the ability to incentivize customers who are risk averse or unable to shed load at a particular time to participate in demand response events without the risk of increased bills that could result from non-performance under a TOU or CPP rate design. This provides an opportunity to educate customers about demand response and encourages conservation on peak days. The Tierra analysis assessed that this bill-certainty plus Peak Time Rebate rate structure would be particularly attractive to residential customers with all electric homes (HVAC, water heat, cooking) potentially attracting 20%-25% of these customers. As another current example of these innovative tariff designs, the Companies have recently proposed a managed charging pilot for EVs that potentially provides both bill certainty and system-beneficial, off-peak charging behavior.

Tierra estimated a contribution of potentially 923 MW of achievable winter peak reduction by 2030 for Duke Energy's Carolinas' service areas. Tierra's study assumed TOU adoption rates ramp up over approximately eight years beginning in 2022-2023. Duke Energy is already following many of the steps in Tierra's road map to achieving this potential, including recently receiving approval for revised and expanded TOU/CPP offers. Importantly, the Companies expect that full achievement of such potential benefits will require new programs and tools developed and deployed rapidly as new technologies

become available. Understanding customer preferences and attitude toward new rates will be absolutely critical to achieve the levels of projected adoption and will require increased flexibility to adapt and introduce new rate offerings and bundles will allow the Companies to iterate to optimal solutions, in some cases failing fast and using lessons learned to introduce alternatives.

Future Rate Design Program Changes (Planned and Proposed)

Modern pricing can provide meaningful system benefits if appropriately designed, well-marketed and supported with advanced digital technologies. While adoption rates for TOU and other dynamic pricing structures have historically been low, subscription rates and enabling products and services may be able to sway customers to experiment with new options if there are reasonable expectations of cost savings and environmental benefits. There is also the potential opportunity to guarantee savings/certainty with subscription pricing.

In response to feedback received during the Comprehensive Rate Design Study stakeholder process, the Companies are developing new hourly pricing programs in North Carolina designed to enable broader, more diverse customer participation, including participation of existing loads. Of note is the potential of hourly pricing in the context of the Carbon Plan even though the specific rate design proposals are beyond the scope of this Plan and will be addressed as part of ongoing, regular rate case proceedings. Customer research indicates customer interest could result in approximately 10%-30% of the current Large General Service ("LGS") customer class (customer with a kilowatt demand of more than 75kW) enrolling in an hourly pricing rate and becoming price-responsive loads. Assuming the midpoint of this range (20% of load moving to a new optional hourly pricing rate) and a 65% load factor, the Companies estimate approximately 790 MW of new price-responsive load as shows in Table G-10 below. This reflects a shift of nearly half of the existing large customer load that could move into such an hourly pricing program.[11]

Table G-10: Potential Increase in Price-Responsive Load from Optional Hourly Pricing Participation

Jurisdiction	Tariff	MWh	MW	Responsive
DEP-NC	LGS-TOU	1,752,903	308	62
DEP-SC	LGS-TOU	213,493	37	7
DEC-NC	OPT-V-PL OPT-V-SL	10,827,904	1,902	380
DEC-SC	OPT	9,695,400	1,703	341
			Total	790 MW

[11] The price responsive peak reduction load estimate reflects only the potential reductions from optional hourly pricing participation and does not reflect the additional load reductions from demand response program participation.

Program Schedule

As the Companies research and vet these and future rate design changes, they intend to use existing forums and rate case proceedings to seek regulatory approval. As part of this approach, the Companies will consider how such alternative rate designs can help support an affordable and reliable low-carbon electricity system and meet other targets of the Carbon Plan.

Program Enablers/Signposts

Table G-11 below discusses opportunities that could enable additional alternative rate designs that drive down demand and shift demand to lower-cost time periods in support of the Carbon Plan and customer affordability.

Table G-11: Carbon Plan Activities and Supporting Needs (Rate Design)

Carolinas Carbon Plan Activities and Supporting Needs (Rate Design)	
All Alternative Rate Designs	Intend to use existing forums and rate proceeding processes • Updating pricing structures to reflect a change in hourly energy costs due to increased solar penetration • Development of new hourly pricing option to enable broader, more diverse customer participation by large business customers • Pilot subscription rates that provide more attractive pricing options for customers who allow the Companies to actively manage some consumption behaviors, creating grid benefits for all customers

About Demand Response Programs

DR customer programs historically reduce system costs through the reduction of peak load by decreasing runtime of older, more expensive generation or the need to purchase power. The generators most likely to be avoided by DR are the most carbon intense resources, and the benefits of DR to the system are reliability and cost savings. Customers are compensated monthly for being willing to reduce demand when needed. With the rise of both renewables and carbon reduction targets, DR is evolving into a tool capable of both peak reduction and load shaping to maximize the utilization of carbon neutral resources and flattening peak demand. More customer participation is required to grow DR's capability to levels identified in the Carbon Plan. The Companies have historically worked with stakeholders through the longstanding EE/DSM Collaborative to address DR programs. Continued engagement through this existing stakeholder engagement process will be imperative to creating increased participation to support the Carbon Plan.

Demand Response Evolution from Peak Shaving to Load Shaping

DR across the country is evolving. One-way paging and manual load reduction are evolving into two-way communication with the utility. Where DR may today be known for its peak shaving capability, in the future it will be thought of as Flexible Demand Management, able to load shape to maximize renewables available at that moment, reducing steep ramping of central generation as the sun sets and taking advantage of over supply scenarios. Duke Energy's expertise in grid management and customer programs will enable this change.

DR capability should be thought of in the context of two use cases – emergency and flexible demand. Almost all the Companies' peak shaving capability today is utilized to maintain system reliability in emergencies. Large customer participants who must shut down their manufacturing lines or reschedule workers are willing to do that work on an emergency basis but not multiple times per month in a manner to truly be considered flexible. Residential and small-medium business participants with heat pump switches are likewise only willing to be uncomfortable on an emergency, short-term basis before they leave the program. Flexible measures are those that minorly inconvenience customers, or better yet, are unnoticed. Non-residential examples include batteries, standby generators and thermostats. Water heaters, thermostats and appliances that could be optimized by smart home devices are products that are low-friction DR resources in the residential customer space. The growth of both the financial incentives and low-friction measures is what will provide the flexible demand management capability needed in the future to maximize renewable kilowatt-hours.

Current State Program Details

Duke Energy maintains winter DR capability through a variety of programs. Residential customers participate through switches attached to an air conditioner, water heater or heat pump, depending on the program or a thermostat. In both cases, the device responds to commands sent by Duke Energy. Large non-residential customers reduce load manually when called upon or have rates that incentivize load reduction when needed. In total, these programs provide nearly 700 MW of curtailable load as shown in Table G-12 below.

Table G-12: Winter Demand Response Programs Currently Offered in DEC and DEP

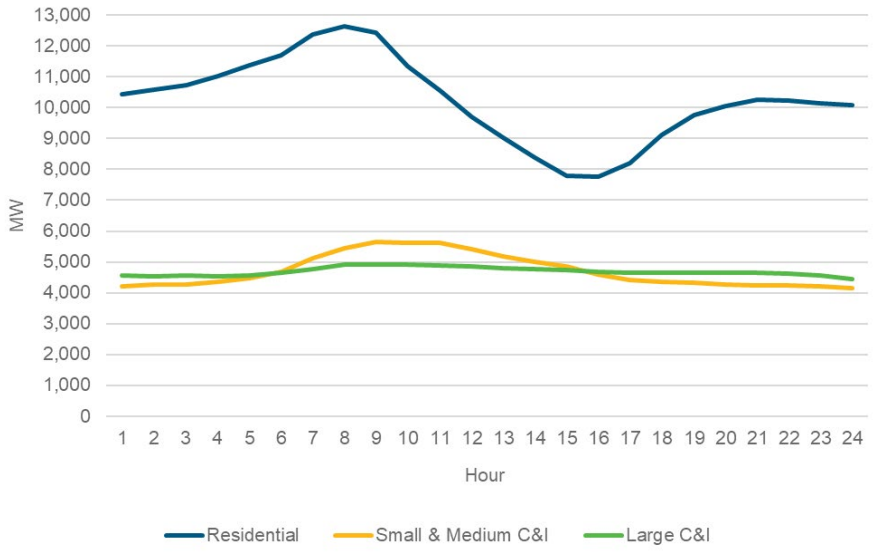
Duke Energy Carolinas – 412 Winter MW		
Residential	Power Manager Switch	0 MW[12]
	Bring Your Own Thermostat	9 MW
Non-Residential	PowerShare	318 MW
	EnergyWise Business	2 MW
	Interruptible Service	81 MW
	Standby Generation	2 MW
Duke Energy Progress – 277 Winter MW		
Residential	EnergyWise Home Switch	14 MW
	Bring Your Own Thermostat	9 MW

[12] The Power Manager Switch program is only for air conditioners, so it does not provide DR in the winter.

Duke Energy Progress – 277 Winter MW		
Non-Residential	Demand Response Automation	22 MW
	EnergyWise Business	0.2 MW
	Large Load Curtailable	232 MW
Total Curtailable Load from Winter Demand Programs in the Carolinas		**≈ 700 MW**

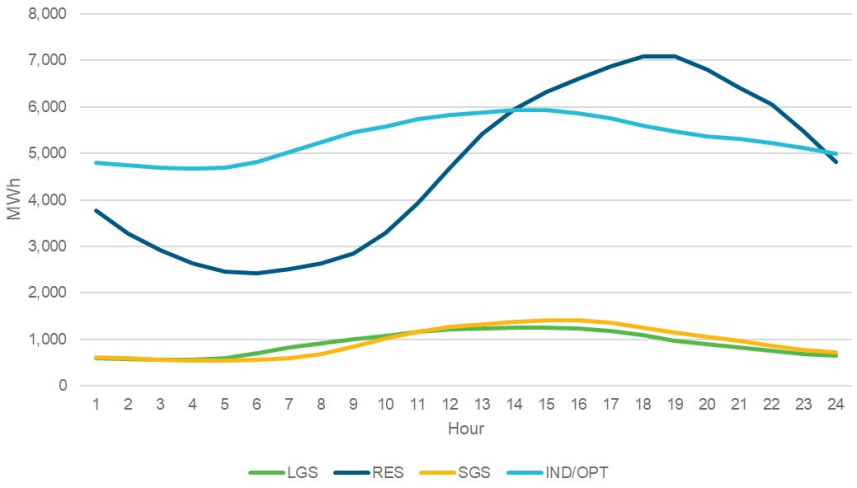
The Companies have historically been summer planning utilities, focusing on offering DR programs that target reducing the summer peak. In 2021, the Companies shifted to planning around the winter peak because of the large increase of intermittent solar generation being put to the grid during the summer, and, accordingly, began an approach to maintain their summer DR capability while only enrolling additional winter peak demand response customers. Figure G-4 below shows how residential customer demand is greatest in the morning, then falls quickly throughout the morning and early afternoon, with some recovery in the evening hours. Therefore, strategies to flatten peak demand must include a focus on residential customers. Without increased residential customer engagement, DR's ability to reduce the winter peak will be minimal.

Figure G-4: 2018 Winter Peak Day – Combined DEC and DEP



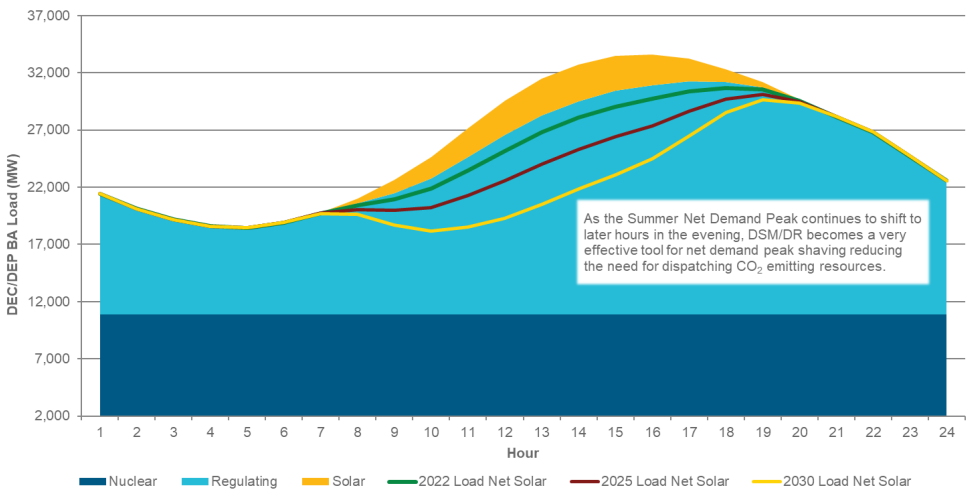
Like winter, summer peak load is being driven by residential customers, primarily space conditioning in the afternoon. In the summer, the Companies' generation will be most needed as solar production ends for the day, and home air conditioning usage is significant. Figure G-5 shows the peak summer day in 2021 by rate type, indicating that the afternoon peak was driven by residential load.

Figure G-5: 2021 Summer Peak Day (DEC System)



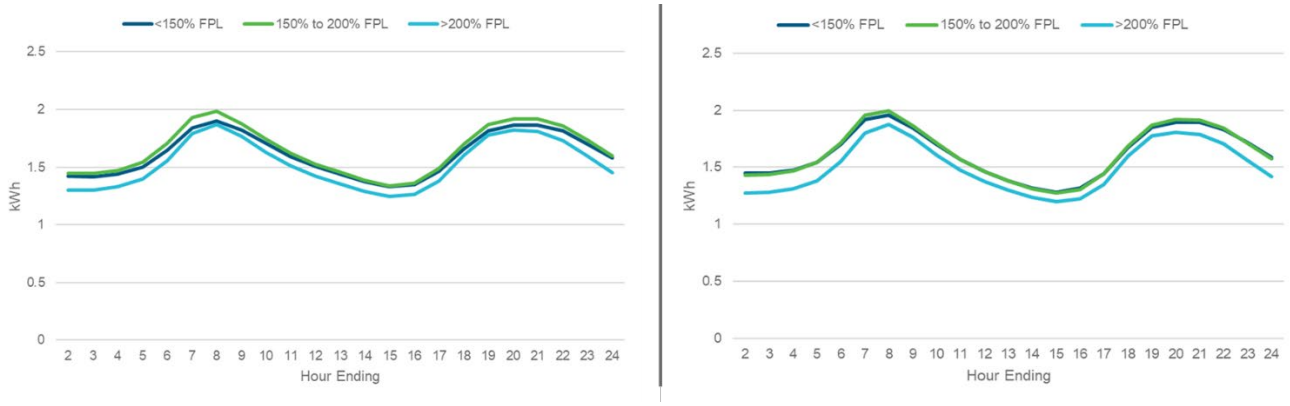
The great operational concern is how quickly central generation needs to become available. Figure G-6 below shows a typical summer afternoon and how quickly central generation resources are needed as the sun sets and customers are arriving home for the evening. DR's load shaping capabilities can help with this.

Figure G-6: Summer Duke Energy Curve Progression 2022-2030



Within residential populations, the need exists to address low-income demand. Figure G-7 below demonstrates that lower-income customers tend to contribute more during peak. About a third of customers participating in residential DR programs today (that are mainly summer programs) earn less than 200% of the poverty line. Partnership and engagement with low-income customers and advocacy groups will be critical for addressing this load.

Figure G-7: Winter Demand on DEC and DEP Systems



Non-Residential Demand Response

Non-residential customers, especially commercial and Industrial customers, may provide a significant resource in the form of contractual commitments to shed load during emergency DR events. When considering program participation, business customers must examine the operational impacts and associated effects to their revenue due to participation, not just the financial incentives they receive from Duke Energy for their contractual obligation to shed load. For many of them, the operational impacts and net financial costs are too high when participating in more frequent non-emergency events. In addition, those with customers on-site are not willing to sacrifice customer or employee comfort for participation. Although their load as a rate class is relatively stable, more participation from large users would help reduce winter peak.

Small-medium business customers without enough load to participate in the contractual-based program available to the larger commercial and industrial customers program can join a thermostat-based DR program. There is currently a negligible amount of winter capability because the program historically focused on summer peak reduction, but beginning in 2021, this program has started to place more emphasis on winter. The small-medium business segment has historically been difficult to reach because business owners tend to place little emphasis on energy usage, let alone programs that shift when they use energy. To date, the lower impacts and high costs of sending the vendor to the business have caused the program's cost-effectiveness to struggle. Capacity is expected to grow from 4 MW currently to 9 MW by 2030. More engagement with small and medium businesses is desired in reaching CO_2 emissions reductions targets.

Residential Demand Response

Growth in DR is more likely to be found within the residential customer segment. The inconvenience of the program is not as substantial as it is for businesses and many customers value the program's environmental benefits.

The most significant component in the suite of DR programs contributing to the reduction in winter peak is the residential Wi-Fi-enabled thermostat program. The program was originally a summer-

focused program started in 2019, and just recently began focusing on winter capability, which is currently 16 MW with 12,000 customers as of January 2022.

Future Demand Response Program Changes (Planned and Proposed)

The Companies are adding resources to thermostat programs to drive adoption above current levels through a variety of initiatives. For example, there are multiple programs where contractors acting on behalf of Duke Energy are in customer homes, sometimes installing thermostats. Enrollment in DR could be included in that process. In addition, purchases of Wi-Fi-enabled thermostats through the Companies' marketplace will expand the opportunity to increase program participation.

Thermostat manufacturers play a critical role in the administration of this capability by setting the parameters for how often and how long DR events can occur. One significant risk associated with over reliance on thermostats as the means for control is that ongoing system control is not guaranteed. If the thermostat manufacturers end their relationship with the aggregators with whom the Companies engage to call events, the Companies will have to establish their own relationships with manufacturers. Currently, the manufacturers do not charge material amounts for DR capability. If that changes in the future, it could impact the cost-effectiveness of the program. The value of the aggregators is that they handle the day-to-day technical requirements of numerous manufacturers for many utilities, lowering the cost for all to administer thermostat programs.

Currently, in the western portion of the DEP service territory, customers can participate in switch-based load control water heater and heat strip programs. There are currently 13,000 customers participating with those appliances for a total capability of 14 MW. Historically, heat strips provide excellent savings at peak, around 1.03 kW per device. Water heaters have great potential to operate without customer inconvenience, but the savings are much smaller.[13] The program cannot be offered economically unless a technician is already at the home installing another device, a significant barrier. At this time, DEC does not believe that a water heater program can be delivered cost-effectively because the measure life is only one year. In DEP, where a 25-year measure life has been used, the program has been cost-effective. The Companies believe that a change to building code, discussed below, could enable much broader participation.

The impact of transportation electrification to peak demand must be closely monitored as noted in Appendix F (Electric Load Forecast) and in the Transportation Electrification section of this Appendix. Residential demand could reach 900 MW. Those customers, left unmanaged, will charge at the times of day most convenient for them and worst for the grid, including mornings when they arrive at work and at home as the sun is setting. Managed charging will be critical to handling daily peak charging load. For non-residential fleet charging, initiatives such as default managed charging to push away from peak will be employed to flatten winter morning load of potentially 1,200 MW.

[13] Navigant Consulting, Inc., *EM&V Report for the EnergyWise Home Demand Response Program Winter PY2018/2019*, at 4 (2019, August 13) (Prepared for Duke Energy Progress, LLC).

Program Schedule / Timeline

The Companies believe that the potential exists to grow the Bring Your Own Thermostat program over the next five years to 206 MW, with over 200,000 customers by 2030, as smart thermostat penetration increases, based on the results of an independent study of the potential for winter peak reduction. This potential growth is inclusive of innovative customer acquisition strategies, such as an eligibility requirement to participate in the winter-focused thermostat control associated with any customer participation in a proposed rooftop solar energy efficiency program.

Thermostats in many cases are an attractive alternative to load control switches, the historic method for controlling space heating and cooling, especially in winter. The home can be preheated with Wi-Fi-enabled thermostats, reducing the potential for customer discomfort during the event. In addition, the thermostat can be set not to allow the temperature to dip below a specific point to safeguard customer safety in cold temperatures. When customers do not perceive a difference in comfort, they are more likely to allow it to be used more often. An experienced program manager now focuses on opportunities to grow this program.

The Companies programs targeting small-medium businesses will be expanded in the first half of 2022 to allow for additional flexibility in the load types that can be incentivized. The program will adopt a model more commonly seen in large businesses where the customer can decide where to reduce load instead of the program being tied to the end use. The Companies intend to make the necessary filings for regulatory approval of this expansion.

The Companies also intend to file for regulatory approval of a heat strip program to control heat pump operation on winter mornings in 2022 in DEC and DEP East, mirroring the program currently available in DEP West. It is projected to have 15 MW of capability after five years.

As noted above, identifying a cost-effective plan for a water heater program has been difficult due to the need for the professional installation of a switch, while the available load shed is small. Startup costs can also hamper cost-effectiveness screens but expanding DR programs for water heaters is a priority. The Companies are investigating whether a pilot could be filed in 2022 for the multifamily space, using new software that will also help the property manager with water heater maintenance.

The EV Managed Charging pilot was filed with the Commission on February 11, 2022.[14] Pending Commission approval of the pilot, the program will be implemented in the near-term. See the Transportation Electrification and Rate Designs discussion in this Appendix for additional details.

[14] DEC and DEP Application for Approval of Proposed Electric Vehicle Managed Charging Pilot, Docket Nos. E-7, Sub 1266 & E-2, Sub 1291 (Feb. 11, 2022).

Program Enablers/Signposts

Building Code Changes

Building codes will significantly influence the availability of critical measures for establishing Flexible Demand Management. The Companies anticipate tremendous curtailable load potential in Wi-Fi-enabled water heaters as the technology is commercially available and not significantly more costly than a standard water heater. In 2021, Duke Energy Florida operators called on the participating water heaters 74 times for an average of 28 minutes through a similar Duke Energy Florida water heater program, typically with participating customers unaware of those curtailments. Wi-Fi-enabled water heaters can significantly reduce or even eliminate these costs, despite the initial large cost barrier of sending technicians to install hot water heater switches. For example, findings from a recent Winter Peak Study suggest that modifying building codes to require demand responsive controls on all water heaters sold in the Carolinas and installed in new homes could add as much as 8 MW of capability every year with a peak demand reduction of 26.2 MW by 2041.[15]

Inclusion of smart panels in building codes provides a ready-made solution for monitoring, measuring and managing EV charging and other sources to manage load on a circuit basis. The capabilities of smart panels benefit customers by delivering granular data on heavy usage in their home and creating a mechanism for behavioral modification to lower their electric bill. The technology has not yet been widely adopted and thus the Companies are not able to assess the potential peak savings. Smart panels are being tested by the Companies, but a pilot at customer locations would be necessary before a broad rollout.

Growing Summer Thermostat Capability

Summer Demand Response has been devalued in recent years due to the need for winter capability. Currently, it is not cost-effective to acquire summer thermostat customers because the system value is limited to only the cost of avoided transmission and distribution. The Companies believe that summer DR capability could be valuable to help modify load shapes and manage distribution capacity for some summer peaking circuits. Additionally, the Companies believe there may be an opportunity for cost-effective summer DR by focusing customer acquisition on customers served by targeted summer peaking circuits. Summer value would further encourage the Companies to expand thermostats beyond homes with electric heat, helping to reduce customer usage and bills. The Companies have also been asked by stakeholders to do more to incentivize thermostat adoption and will leverage the Integrated System and Operations Planning process as discussed in Appendix S (Integrated System and Operations Planning ("ISOP")) to further evaluate additional value for summer DR.

[15] Tierra Resource Consultants in partnership with Dunsky Energy Consulting, *Winter Peak Analysis and Solution Set*, at 19 (Aug. 2020) (prepared for Duke Energy).

Cost-Effectiveness Test Flexibility

Bringing new products to market can be expensive until they reach scale. As noted above, water heaters represent significant strategic value as a measure that can provide reliable savings with little customer impact, but they have proved difficult to introduce cost-effectively, especially in DEC. Flexibility in cost-effectiveness tests and/or accepted measure life may help bring this program to the market, as water heaters are known to Duke Energy and other companies as effective measures when a program has reached scale. Tackling customer financial and convenience issues inherent in the use of DR will enable greater levels of program participation.

Non-Residential Demand Response Rider and Flexible Demand Management Economics

Currently, it is only economical for commercial and industrial customers to participate and pay into the rider if they are going to include all of their load in the program. The load reduction for commercial and industrial customers is not automated. Most customers manually reduce load when called upon, but it is viewed as an action reserved for emergencies only. It is unlikely that customers will want to reduce almost all of their load multiple times per year. There may be many customers who would be willing to commit smaller levels of load to a DR program but are unable due to the economics of the rider. Creating a path for customers to contribute smaller loads, with the requirement of automated controls capable of communicating with the Companies, could result in a significant quantity of incremental capability.

Participant incentives are the main expense in the DR rider, therefore increased participation may push the cost too high for some PowerShare participants, causing them to leave the program and opt-out. For Flexible Demand Management to be used in balancing the supply and demand on the grid as described, innovative and unavoidable cost-recovery mechanisms may be necessary.

Customer Compensation and Convenience

Residential customers receive between $25 and $100 per year to participate in DR programs that come with the expectation that the programs would be used sparingly and cause little impact. Not only are customers potentially uncomfortable during an event, but many are hesitant to give Duke Energy access to appliances in their home. To employ DR on a more frequent basis, more compensation to customers will likely be required. Wi-Fi-enabled thermostats will be critical to managing peak demand, and until recently, cost $70-$200. Against Duke Energy's first year incentive of $75 and ongoing incentive of $25/year, the customer would need to participate for up to five years to earn back their investment if they were able to install it themselves. Messaging around the significance of DR to the reliability and increasingly clean operation of the grid is important, but what really drives participation is the financial reward. Unlike non-residential customers, residential customers only receive a capacity credit. Paying customers event credits is also likely to help with customer satisfaction with events. Value centered solely on the traditional DR capability does not capture the full power that can be unlocked through customer participation. The introduction of lower friction measures will allow the system to be used more, thus creating more overall value and enabling greater bill credit potential. The switch incentive has remained static for many years while avoided cost has fallen and rates have increased, diminishing the value of the program to bill reduction.

Even when compensation is increased, sustained participation will only happen if customers are not inconvenienced. Wi-Fi-enabled thermostats are the only widely available appliances today, but more are coming. Across all heating and occupant types, only 21% of residential customers have a Wi-Fi thermostat, the most common smart home device. The integration of Wi-Fi-enabled end users with a smart home device enrolled in a DR program would allow the utility to orchestrate the energy use in the home to the benefit of the grid. Storage and EV battery charging may also be controlled by smart home automation. The Companies are currently studying how residential batteries can participate in DR programs, but it is too early to assess technical capability and customer interest.

Non-residential customers may be more apt to participate in flexible demand management programs using a battery or generator to continue powering their businesses during events. Loss of their ability to generate revenue during an event is what impedes greater participation. To reduce CO_2, the battery is preferable, but the cost exceeds that of the generator currently. In addition, there are still customers with diesel generators. Targeting customers with carbon-intense generators and providing them with additional incentives to purchase new or upgrade their existing generators benefits both the utility in the form of flexible demand management opportunity but also the employees and neighbors in the form of cleaner air.

A significant area of opportunity is the use of energy management systems. This technology allows customers to set preferences for energy use based on business. The next generation of systems can also optimize energy usage with sensors. Guidehouse research predicts 2.8% compound annual growth rate growth through 2029, predominately in retail, education and office sectors.[16] Barriers to adoption include the cost of first-time technology integration or replacement of an existing system. The Companies would like to integrate with these systems to reduce load when needed in ways that may not be noticeable to occupants, such as dimming lights or slightly reducing refrigeration or indoor air temperature. This type of DR is called Automated Demand Response. A consortium of stakeholders has developed a protocol called Open Automated Demand Response, a standardized interface that will simplify DR implementation at utilities by avoiding potentially difficult integrations with multiple vendors. With a DR program to help fund them, the winter peak analysis estimate 35 MW could be enrolled in this type of program by 2031. The Companies are aware that the Infrastructure Investment and Jobs Act recently passed by Congress may enable federal government customers to install these systems and will be watching for development of processes to access the funds. Table G-13 below details Demand Response program activities and needs to enable program participation growth.

Table G-13: Carbon Plan Activities and Supporting Needs (DR Programs)

Carbon Plan Activities and Supporting Needs (DR Programs)	
Summer Thermostat Growth	• The Commission's approval of the need to acquire customers for summer flexible demand management
Program Approvals	• Heat Strip program approval from the Commission (expect to file for approval in 2022)

[16] Guidehouse, *Building Automation Solutions for Commercial Buildings (*2020).

Carbon Plan Activities and Supporting Needs (DR Programs)	
	• Expanded program targeting Small-Medium Business customers will require approval from the Commission

About Voltage Optimization

Voltage Optimization performed through a function called Integrated Voltage/VAR Control ("IVVC"), is the coordinated control of substation and power line equipment to manage voltage and power factor on distribution circuits. In DEP, by operating DSDR in peak shaving mode, operators may lower voltages on a circuit during times of high energy demand, delaying the need for peaking generation assets. Another operational mode, Conservation Voltage Reduction ("CVR"), supports energy reduction on a year-round basis. CVR enables sustained voltage reduction, which ultimately reduces the amount of fuel required to meet customer demand. The devices installed to enable voltage optimization also help to modernize the grid and improve voltage management to customers.

Beyond its ability to directly provide CO_2 reduction, the grid will be enhanced to manage two-way power flow. Two-way power flow on a circuit can occur when solar and other DERs produce excess generation. Implementation of the IVVC program will help transition the grid to manage power flow as DER penetration increases.

Voltage optimization capabilities lead to:

1) Less peak load on the grid, which could result in a reduced need to build additional peaking generation assets.
2) Optimized control of Volt-VAR devices, improving the grid's ability to respond to dynamic system conditions, such as DER [solar] intermittency, while delivering reduced distribution line losses.

Current State Program Details

Today, the DSDR function provides peak shaving capabilities across the DEP footprint, allowing operators to reduce system peak when deemed necessary. DEC is systematically deploying assets to help support future voltage optimization. While DEC is designing IVVC to dynamically support the needed modes of either peak shaving and CVR mode, DEP DSDR solely provides peak shaving; however, using the Distribution Management System ("DMS") along with the deployment of targeted control devices sensor adjustments, DEP could equip the existing voltage optimization system with the CVR operating mode to reduce even more fuel consumption.

Plans for More CVR in DEC

In the effort to fully implement IVVC across the DEC footprint, DEC is deploying the needed devices in two phases. The DEC IVVC Phase I scope accounts for approximately 67% of the total circuits (73%

of eligible circuits) across DEC. This will enable voltage reduction capabilities for approximately 70% of DEC current base load.

The current plans for DEC IVVC Phase II include equipping an additional 17% of DEC's circuits with voltage reduction capabilities that will enable voltage reduction capabilities for an additional 10% of current base load. Lastly, Phase III will be implemented so that IVVC can achieve its maximum potential of successful installation across 96% of eligible circuits in the DEC service territory, representing approximately 82% of base load.

Table G-14 below highlights the percentage of all DEC circuits equipped with IVVC capabilities compared to the percent of IVVC eligible circuits and the approximate percent of total base load that the IVVC function will affect.

Table G-14: IVVC – Percentage of Circuits in DEC

IVVC Deployment Phases in DEC	Percent of All Circuits	Percent of *Eligible* Circuits	Approx. Percent of total base load
Phase 1	67%	73%	70%
Phase 2	16%	17%	10%
Phase 3	6%	6%	2%
Total	**89%**	**96%**	**82%**

To maximize operational flexibility and value, the future DMS can support additional operating modes, such as peak shaving capability and emergency modes of operation. When the phases of IVVC are deployed, DEC intends to operate in CVR mode approximately 90% of the hours in the year. Approximately 10% of the peak hours will be allocated to other IVVC operating modes.

The DEC CVR plan targets an estimated 2% voltage reduction. Through initial testing, DEC determined that it achieves this voltage reduction target when operating the system at an average CVR factor of 0.7.

Plans to Introduce CVR in DEP

In contrast to DEC, DEP already has peak-shaving capability thanks to the legacy DSDR program that achieved full functionality in July 2014 across 97% of eligible circuits. DEP is currently working to expand the capabilities of the existing DSDR equipment beyond peak shaving to support CVR.

The DSDR and CVR modes of operation will be implemented by the software within a centralized DMS. The original assumption was that a transition between operational modes was not possible. Based on updated assumptions, DEP does not expect that changing the predominant operational strategy from DSDR to CVR will reduce peak shaving capability available today. The new DMS in place today has the capability to transition between different modes of operation. Therefore, coming out of CVR would allow the system to return to a steady state that supports the current levels of peak

shaving. Enhancements to the DMS and field devices will provide flexibility for both capacity and energy-saving capabilities while preserving options for efficient management of the grid.

The DEP CVR plan targets an estimated 2% voltage reduction. Based on initial testing, DEP will be using an average CVR factor of 0.7. A voltage reduction of 2% driven by CVR technology roughly equates to a 1.4% reduction in load for CVR-enabled circuits. Importantly, DEP's updated cost-benefit analysis for adding CVR operational capabilities to DSDR continues to show this program is beneficial to customers. Tables G-15 and G-16 below summarize the MW and MWh reduction forecasts in DEP and DEC, respectively.

Program Schedule

Table G-15: DEP DSDR to IVVC Conversion: CVR MWh Reduction Forecast (90% of Hours) / Peak Shaving MW Schedule (10% of Hours)

Year	Deployment (%)	Energy Reduction (MWh)	Peak Shaving (MW)
2022	0%	CVR Not Applicable	158
2023	10%	38,777	160
2024	20%	78,252	160
2025	100%	394,782	161
2026	100%	398,335	162
2027	100%	401,920	164
2028	100%	405,537	165
2029	100%	409,187	167
2030	100%	412,870	168
2031	100%	416,586	170
2032	100%	420,335	172
2033	100%	424,118	173
2034	100%	427,935	175

Table G-16: DEC IVVC: CVR MWh Reduction Forecast (90% of Hours) / Peak Shaving MW Schedule (10% of Hours)

Year	Deployment (%)	Energy Reduction (MWh)	Peak Shaving (MW)
2022	0%	0	0
2023	10%	30,607	(17)
2024	20%	61,766	(34)
2025	35%	314,795	(175)
2026	50%	320,843	(178)
2027	65%	349,680	(197)
2028	80%	352,827	(199)
2029	95%	356,003	(201)
2030	100%	359,207	(203)
2031	100%	362,440	(205)
2032	100%	365,702	(206)
2033	100%	368,993	(208)
2034	100%	372,314	(210)

Program Enablers/Signposts

Table G-17 below summarizes ongoing and future activities to support and enable voltage optimization efforts in DEC and DEP.

Table G-17: Carbon Plan Activities and Supporting Needs (Voltage Optimization)

Carbon Plan Activities and Supporting Needs (Voltage Optimization)	
DEC CVR Phase 1	• Regulatory approval received • Project in-flight
DEC CVR Phase 2/3	• SC: To be submitted with Grid Improvement Plans extension by Q3 2022 • NC: To be submitted with Multi-year Rate Plan
DEP CVR	• Regulatory approval received • Project in-flight

About Transportation Electrification and Managed EV Charging

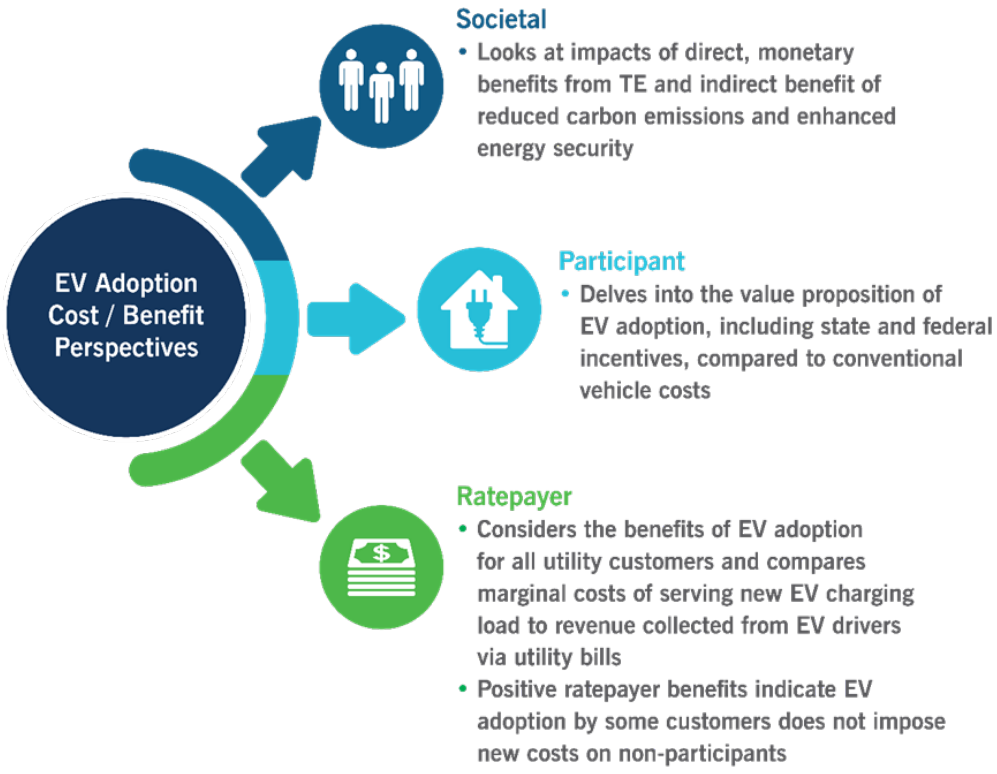
Transportation represents 26% of total U.S. energy use[17] and 29% of CO_2 emissions[18] making electrification of this sector key to achieving the State's decarbonization targets. These targets include, as set forth in the recent Executive Orders 80 and 246, increasing the total number of registered, zero-emission vehicles to at least 80,000 by 2025, at least 1,250,000 by 2030 and increasing the sale of zero-emission vehicles so that 50% of in-state sales of new vehicles are zero-emission by 2030. Transportation electrification provides significant benefits to utility customers and society, but it also poses notable challenges tied to accelerating adoption of the technology and managing expected load impacts. Figure G-8 below presents the factors included in establishing the costs and benefits of EV adoption[19] at the societal, participant and ratepayer levels. Addressing each perspective in developing transportation electrification programs is critical in successfully offsetting CO_2 emissions and Duke Energy has proposed several programs to better enable customers in their EV transition.

[17] U.S. Energy Information Admin, Use of energy explained: Energy use for transportation, https://www.eia.gov/energyexplained/use-of-energy/transportation.php (last visited May 14, 2022).

[18] U.S. Environmental Protection Agency, Sources of Greenhouse Gas: Transportation Sector Emissions, https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#transportation (last visited May 14, 2022).

[19] Energy &Environmental Economics, ICF, & MJ Bradley & Assoc., Benefit-Cost Analysis of Electric Vehicle Deployment in New York State, NYSERDA Report Number 19-07 (Feb. 2019) (prepared for New York State Energy Research and Development Authority (NYSERDA)), *available at* https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Transportation/19-07-Benefit-Cost-Analysis-EV-Deployment-NYS.pdf.

Figure G-8: Electric Vehicle Adoption Cost and Benefit Perspectives



Current State Program Details

Today, transportation electrification programs are largely directed toward market enablement, increasing EV accessibility and laying a foundation for a managed system in the future. By 2030, Duke Energy is expected to directly enable substantial incremental load growth (over 500 annual GWh) in EVs resulting in a reduction of over 1.9 million tons of carbon (tailpipe net of generation) for the State, which is equivalent to removing 1,704 GWh of coal-fired generation. Although there are net reductions because tailpipe emissions eliminated outweigh added electric generation emissions, there is nonetheless additional load on the electric system. Figure G-9 and Table G-18 provide

Figure G-9: Increasing EV Miles Driven Leads to Increasing Generation Load

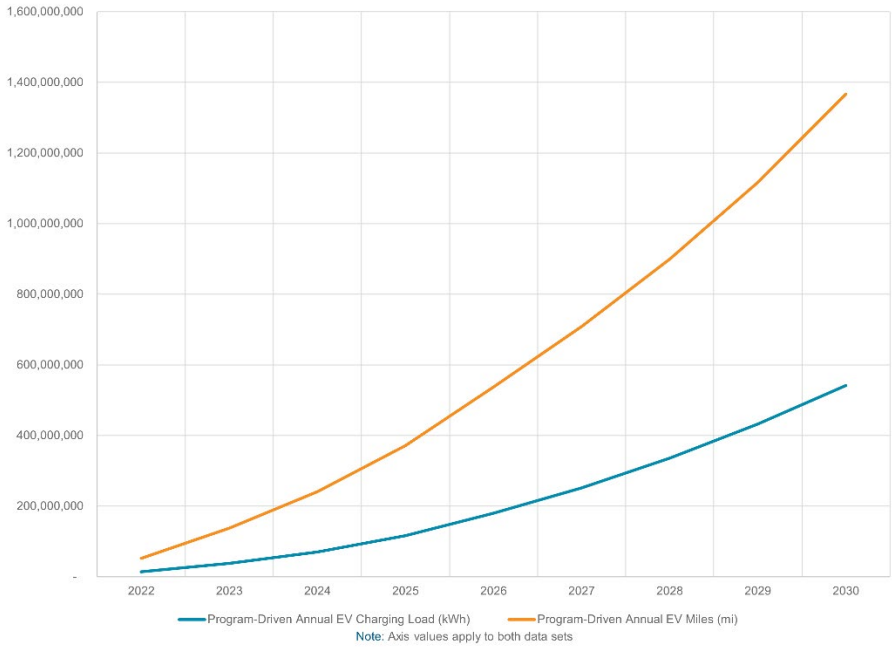


Table G-18: Increasing EV miles Driven Leads to Net Carbon Reduction Statewide

	Cumulative Total NC and SC (Miles)	Cumulative Total NC and SC (Tons CO_2)
2022	51,983,089	3,887
2023	189,611,089	35,079
2024	430,937,272	103,083
2025	802,710,082	220,759
2026	1,339,898,805	405,575
2027	2,048,599,406	662,628
2028	2,948,630,386	1,000,702
2029	4,065,212,007	1,428,224
2030	5,431,757,658	1,956,423

Pilots

Duke Energy has developed several pilot programs to support overall market enablement and to capture critical early utility learning as to what it takes to operate EV charging infrastructure. These pilots better equip the Companies to serve customers and third parties who will seek to establish charging infrastructure and solutions in the future; however, the pilots are not purpose-built to create the managed charging environment required to maximize CO_2 reduction benefit. Duke Energy also engages with the Electric Transportation Stakeholder Group, which is co-sponsored by NCUC Public Staff, to share feedback on the progress of pilots as well as to discuss future programs and plans. More can be found on stakeholder engagement in the transportation electrification space in Appendix B (Stakeholder Engagement). Details of the Companies' active Phase 1 EV Pilots and pending Phase 2 EV pilots are shown in Figure G-10 below.

Figure G-10: Electric Vehicle Pilot Programs

Park & Plug Pilot	EV School Bus
• Phase 1 is in progress until Q4 2023 • Pilot provides charging infrastructure for Duke Energy owned and operated public charging stations • Pilot planned installation of 40 direct current fast charging ("DCFC") in North Carolina along highway corridors, 160 Level 2 stations at public locations, and 80 Level 2 stations at multifamily dwellings • Phase 2 plans to increase installations across each segment (on hold)	• Phase 1 is in progress until November 2023 • During the pilot, Duke Energy intends to offset the purchase of 30 electric school buses to gather operational data and explore the capabilities of the vehicle-to-grid technology • Duke Energy installs and owns the applicable EVSE and retains the right to repurpose batteries • Phase 2 proposes to increase the count of electric school buses to 60 (on hold)

Near-Term Enablers

Charger Prep Credit and Charger Solution are foundational and necessary steps towards establishing a platform for customer connectivity and managed charging in both the residential and non-residential sectors. Figure G-11 below provides further discussion of the status of each of the pilot programs.

- Charger Prep Credit (also known as Make Ready Credit) provides for infrastructure to power from the grid to the point of connection to an EV charger. In addition to providing a funding source for customers, it creates a meaningful and attractive mechanism through which customers may engage the Companies for assistance with this infrastructure. In turn, that engagement can be leveraged to drive participation in managed charging and associated rates.

- Charger Solution (also known as Electric Vehicle Supply Equipment Tariff) provides for charging hardware (the charging device itself) and software to operate the charger. As with Charger Prep Credit, customers who leverage the Charger Solution have inherent access to future solutions and rates for charging management. Moreover, the Charger Solution program itself could be an avenue for customer-operated charging management devices and software.

Figure G-11: Electric Vehicles Pilot Programs

EV Charger Prep Credit (Make Ready Credit)	Charger Solution (Electric Vehicle Service Equipment ("EVSE"))
• Filed in April 2021 • Approved in February 2022 • Program launching effective Q2 2022 • Program offers a one-time credit to customers to prepare their home or business for an EV charger • Program design aims to manage the primary anticipated direct contributors to load growth expected to be 500 GWh • Residential customers can either choose to hire their own electrician or choose a prescreened Duke Energy contractor to complete behind-the-meter retrofits in a safe and reliable manner • Non-Residential customers will work with Duke Energy to access energy needs, associated impacts on existing distribution assets and choose a contractor to perform the work	• Tariff filed in May 2021 (on hold) • EV charger rental program for residential and non-residential customers • Program allows participants to select a charger to be installed for a flat amount each month • Monthly fee includes the charger, installation, and maintenance/warranty • Residential customers can choose a Level 2 charger and non-residential customers can select either a Level 2 charger or fast charger to rent

While Charger Prep Credit is approved in North Carolina, approval and launch of both programs throughout the Carolinas will truly set the stage for EV load management. For successful CO_2 emissions mitigation, EV charging must be synonymous with utility programs.

Future Transportation Electrification Program Changes (Planned and Proposed)

To accommodate additional load while reducing carbon from generation, a collection of rates, deployed assets and customer programs will be necessary. In addition to the foundational programs described above, the following are anticipated as critical to managing a system that supports electric transportation. While it is early to create detailed program descriptions or estimate load impacts, various teams are actively collaborating on these solution elements.

Rate Designs

- Off Peak Credit Programs – Early program results in South Carolina show that customers are willing to adjust their charging behavior at home in exchange for reasonably small monthly payments for periods of time are relatively static throughout the year.

- Time-of-Use Pricing – As with Off Peak Credit, static time-of-use rates can be applied to EV charging loads as a matter of course.

- Dynamic Time-of-Use Pricing – Given that low-carbon generation is not consistent on a day-to-day basis, testing and launch of rates that allow and encourage customers to respond to changing conditions may be even more effective in reducing total CO_2 emissions.

- Utility Managed Curtailment – To the extent that their ability to use their vehicle(s) as required for their daily lives or business operations is not impeded, customers may be willing to allow the utility to manage charging directly for emergency events.

- Subscription EV charging programs incorporating all or some of the above.

Such a program for residential customers is pending before the Commission.

Products and Services

Battery Storage Systems

- While they may also be used as a temporary capacity "bridge" to help meet customer electrification timelines, battery storage systems will serve a critical permanent role to buffer EV charging – particularly for large load fleets – from the grid to manage system demand.

- These systems will also provide for resiliency. While not a long-term generation option, battery buffers can enable a customer to withstand short system outages without reduced operational impact. This could reduce any rebound effect of customers seeking to catch up from an outage and, as a result, abandoning managed charging protocols.

Customer Consultation Services

- Fleet customers will require significant guidance. Sophisticated customers may already understand load management because they understand the monetary impact of demand charges, but they will rarely be well-equipped to navigate the complex matrix of distribution service construction timelines, battery storage capacity bridges and buffers, charging management technology and distributed, renewable generation.

- Other non-residential customers will also seek (and are already seeking) utility guidance not only on system sizing but on how to minimize the service connection impact of larger EV charging installations. To the extent required, the Companies will seek Commission approval of the provision of these services.

Program Enablers/Signposts

For any offering created to support the growth and balancing of transportation electrification needs, multiple options and permutations will be necessary to allow customers to go about their daily routines with varying mileage, use cases and business functions that will range from direct fleet operation to

customer amenity EV charging. Programs and rates must be designed for customer convenience and to minimize disruption.

Additionally, technology maturity, standardization and interoperability will enable cost-effective program deployment. Today, hardware-centric smart charging solutions are either expensive, unreliable or both, at least in a residential setting. It is not completely clear if smart distribution panels, direct-to-vehicle communications, other future technologies or an improvement in hardware options will create a low-cost means of load shaping; however, achieving cost-effective load management technological solutions is of concern. To that end, ongoing collaboration and integration with vehicle original equipment manufacturers is a critical path effort; while not proven or cost-tested at scale, vehicle-centric load management is viewed as the most elegant solution today.

Finally, the ability to reliably harness bi-directional charging may unlock a multitude of dual use rolling assets. Today, vehicle-to-grid, vehicle-to-home and vehicle-to-X is in commercial infancy. At maturity, its potential to shape load, provide for power quality control and serve in back-up power situations is considerable.

About Self-Optimizing Grid ("SOG")

The DEC and DEP electric systems were originally designed support a constant flow of power, in a single direction, from large, centralized power generating stations to end-use customers. As distributed zero-carbon resources, such as solar, become a greater portion of the Companies' generation resource mix, the characteristics of the power (such as *where* power is generated, the direction of the power flow and the amount of variability of the power produced), will change significantly. Preparing for this major shift away from central generation and toward distributed and zero-emitting resources required Duke Energy to rethink the capabilities and supporting design of the electric distribution system.

The SOG program implements a set of new design guidelines for the distribution system that will allow the grid to support greater amounts of these new clean energy resources. Distribution circuits with SOG functionality are subdivided into isolatable segments and equipped with intelligent controllers that can automate any grid reconfigurations needed. This evolution in system design provides Duke Energy the ability to dynamically operate the electric grid in ways that will maintain service reliability as the Companies transition to greater solar generation and other emission-free resources.

While the SOG functionality to-date has been largely leveraged to automatically reduce the number of customers affected by power outages, the rapid reaction, control capabilities and capacity provided by SOG are the very same capabilities needed to rapidly respond to varying power flow shifts and fluctuating power generation commonly associated with distributed wind and solar resources.

The SOG design guidelines call for the electric system to be divided into circuit segments that are three miles in length, able to serve approximately 400 customers, or able to serve 2 MW of peak load. Duke Energy's SOG program focuses on segmenting circuits and equipping those segments with four major critical needs: capacity, connectivity, automation and intelligence.

The Companies' long-term vision is to serve 80% of DEC and DEP customers via SOG-designed circuits. The SOG design guidelines not only help to ensure the long-term availability of reliable electricity at the least reasonable cost for their Carolinas customers, but prepares the region for the next generation of electric services likely to include neighborhood-level microgrids supported by community solar, battery storage and other DER.

Program Enablers/Signposts

Carbon Plan Activities and Supporting Needs (Self-Optimizing Grid)	
General needs/risks	• Supply chain risks (long lead time equipment, switch gear, transformers) • Workforce (engineering, DER)

About Enterprise Communications Advanced Systems ("ECAS")

Customers expect the grid of the future to be able to handle two-way power flow and the introduction of DER and EV technology without any change to how they use electricity today. To facilitate this new future, reliable and resilient communication infrastructure needs to be installed to communicate with all the grid edge intelligent electronic devices.

Duke Energy's ECAS program addresses technology obsolesce, secures vulnerabilities and provides new workforce-enabling capabilities through modernizing and securing the critical communications between the Companies' grid management and control systems and the considerable number of intelligent field devices required to eliminate net carbon emissions from the DEC and DEP systems. These ECAS tools ultimately equip the electric system with the ability to detect and adapt to changing grid conditions resulting from dynamic resources like solar and EVs.

The ECAS program includes improvement and expansion of the entire communications network from the high-speed, high-capacity fiber optic and microwave networks to the wireless connections at the edge of the grid. These upgrades help build the secure communications required for the increasing number of smart components, sensors and remotely activated devices on the transmission and distribution systems. In addition, the network will be the backbone for communications to DER, utility-owned and third party, to facilitate the new two-way power flows that accompany this new equipment.

Program Enablers/Signposts

Carolinas Carbon Plan Activities and Supporting Needs (Enterprise Comm Advanced Systems)	
Enterprise Comm	• Qualified workforce (availability of installers in a competitive market) • Supply chain (availability of components)